THE

ELECTRICAL REVIEW.

VOL. XLV. JULY 21, 1899. No. 1,130.

CONTENTS:

	PAGE
The Stranger Within our Gates	85
Institution of Mechanical Engineers (*illustrated*)	87
Indispensable Accessories of Electric Traction (*illustrated*) (*continued*)	88
Reviews:—Unités Electriques Absolues. Leçons Professées à la Sorbonne	91
Municipal Electricity Supply	92
Dictionnaire Technique Francais-Anglais, des outils et utensiles employés sans les métiers manuels, la petite industrie, le ménage, &c.	93
Correspondence:—	
The Price of Electrical Energy at Morecambe	93
Electrolytic Methods of Zinc Extraction	93
Disclaimer	93
Legal	93
Parliamentary Committees	94
Business Notices, &c.	95
St. Helens Corporation Electricity Works and Tramways (*illus.*)	105
Notes	111
City Notes	113
Traffic Receipts	116
Stocks and Shares	116
Share List of Electrical Companies	117
Market Quotations	118
Accumulators for Automobiles	119
Municipal Electrical Association:—	
Condensers for Electric Light and Power Stations ...	120
Electrical Motor Carriages (*illustrated*)	122
The Volta Centenary (*continued*)	123
The Installation of Steam Boilers.—IV. (*illustrated*)	124
Installation Estimates (*illustrated*)...	126
New Patents	127
Abstracts of Published Specifications	127

THE

UNIVERSAL ELECTRICAL DIRECTORY

1899

Edition

Price 6s.

NOW READY.

H. ALABASTER, GATEHOUSE & CO.,

4, LUDGATE HILL, LONDON E.C.

THE ELECTRICAL REVIEW.

Published every FRIDAY Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON.

Telegraphic Address: "AGENCY, LONDON." Code A B C.
Telephone No. 988 Holborn.

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades.

SUBSCRIPTION RATES.—In *Great Britain*, Post Free per Year, 19s. 6d. To all *other countries*, per Year, £1 10s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each.

READING CASES, to hold from One to Twenty-six Numbers until the Volume is complete for Binding, can now be had from the Publishers, Price 6s, or Free by Post (in Great Britain), 6s. 6d

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. *Paris:* VEUVE J. BOYVEAU 23, Rue de la Banque. *Berlin:* ASHER & Co., 13, Unter den Linden.

Cheques and Postal Orders (on Chief Office London, to be made payable to MR H. ALABASTER, 4, Ludgate Hill, E.C.

THE STRANGER WITHIN OUR GATES.

ANYONE but a close student of electrical affairs would be filled with surprise at the enormous amount of work which is being carried on at the present moment by electrical contractors; indeed, it can hardly be doubted that in electrical matters we are passing through a period of extraordinary activity. There is hardly a manufacturer who is not suffering from a superabundance of orders, with the inevitable result that he has been rapidly falling in arrears.

Nor does there appear to be any immediate prospect of a slackening in the demand for electrical plant. Electrical tramways are being constructed all over the country; the municipalities or supply companies of large towns are employed in carrying out extensive additions to their already existing works, while towns that have been hitherto difficult to win over to the advantages of a public supply of electricity are engaged on schemes. Nor do these represent the only directions in which plant is being utilised. In all parts of the country manufacturers, and owners of factories and workshops, are becoming alive to the advantages of electrical driving, and the instances where scattered steam engines and shafting are being abolished, in order to make room for modern methods, are multiplying. In addition there is a growing use of electricity in chemical operations, and in this direction alone there ought eventually to be a large outlet for electrical machinery.

Having regard to the enormous use that is being made of electrical plant, coupled with the fact that English workshops are in a highly congested state, it is not surprising that foreign electrical manufacturers should have contemplated invading the English market, with a view to obtaining some share of the business. Already the Germans have shown a certain degree of activity in forming companies designed to carry on manufacture here on German methods. The instance of the Schuckert Company is fresh in the minds of our readers; while rumour has been of late busy with the name of a second well-known Continental house.

The formation of the British Westinghouse Company, with a capital of £1,500,000, for the manufacture in this country of every description of electrical machinery is an event of the first magnitude. For some years past a branch of the American Westinghouse Company has been located in London, and has presumably secured a fair share of profitable business. It is the intention of the new company to carry on its business on an exceptional scale, and for that purpose it has secured in the neighbourhood of Manchester, adjacent to the Ship Canal, a large area of land which will permit the erection of buildings able to accommodate, in the first instance, 5,000 workmen.

The English daily press has a woeful lack of knowledge concerning English electrical manufactures, and it is not surprising, therefore, that the Westinghouse scheme serves as an occasion upon which it laments the smallness and backwardness of the British electrical manufacturer. Even

a newspaper so usually well informed as the *Pall Mall Gazette* says: "It is notorious that for the better part of the electrical apparatus employed in this country we go abroad to the United States or Germany." Hitherto, the German interests in this country, as far as importation of electrical machinery is concerned, have been insignificant; but in the development of electric traction the Americans have for some time exerted a controlling influence. It is not difficult to assign reasons for the pre-eminence of Americans in this direction. They came into the English market with their plant cut and dried, and were able to offer complete equipments that were based on years of experience. While electrical men in this country were fighting the battle of the overhead wire, their American *confrères* on the other side were putting up lines in all directions, and evolving the most suitable type of plant. When, therefore, the English public had become educated up to the trolley systems, our home manufacturers had had little or no experience; and, naturally, the American who could supply a finished article, obtained much of the business. But if we examine a list of the electric lighting works in this country we find that very little American plant is in use; indeed, there is probably not more than one electric lighting works in the whole country that is fitted throughout with American-made machinery. In that branch of the industry, English manufacturers have in the past held their own; and, indeed, for ordinary lighting plant of moderate size, we believe that home manufacturers could supply a good deal cheaper than our American friends. But then the tendency of the lighting engineer is towards large units and three-phase systems, and in both these directions the Americans have gone far.

In traction work, which American contractors have practically made their own, there is one important fact to be borne in mind. Up to the present moment American contractors have had practically no competition from their English rivals. Naturally, that state of things is not going to continue, and we are confident that before many months are past more than one English contractor will be able to do battle with his doughty American opponent. The competition which has been hitherto carried on, such as it is, has been with machinery made in the United States; but the question becomes totally different when the Americans put down a factory to compete with us on our own ground. Let us examine the influence that such a departure is likely to exert on home manufacturers. It is beyond dispute that the Westinghouse Company possesses some most valuable patents for electrical machinery, and what is of quite, if not greater importance to such a company is, it has at its disposal a fund of accumulated experience which must enable it to meet very readily new problems as they arise. In this respect it is probably in a superior position to an English company. That, however, is not the whole of the matter. It has been always assumed that the American contractors, when competing with English manufacturers, had the advantage of standardisation and better labour conditions. No doubt the Westinghouse Company will be able on this side to carry out its admirable standard practice, but where will the improved labour conditions be? Designedly the company will employ British labour; in other words, they will be subject to all the vagaries of labour that are experienced by other manufacturers. American methods may count for much, but they cannot, at any rate in this country, rise superior to the British workman, and the attitude of such labour champions as Messrs. Burns and Barnes will probably be watched with interest, if not with some anxiety. It is not very long ago that large tramway works were opened at Preston, and these are being run on American lines, and in a great measure by American engineers; but have they been wholly able to counteract the deep-set labour notions that prevail among many of their workmen? County Councils and municipalities, with few exceptions, insist upon labour clauses in their agreements, and though they have been prone to modify these conditions in American contracts, they are not likely to relax their regulations when a company employs labour in this country. It is quite likely that we may witness on this side a repetition, in a mild form, of the great trust companies that have become an integral part of the financial state of America; but while large electrical companies in America have carried out some magnificent work, and have unmistakably developed a certain class of machinery, it is entirely another question as to whether they have achieved any very striking financial success. A favourite method in America in dealing with competitors is to buy them out; but there would be always greater difficulty in following out such practices in this country. Moreover, it must never be forgotten that the owners of many large contracting works in England are exceedingly wealthy, and the raising of fresh capital for extending works would never be difficult to achieve. It cannot be denied that the new Westinghouse Company is in a strong position, and will be able, no doubt, to meet the stress of competition; at the same time, despite its accumulated knowledge and experience, it would be a mistake to underrate the strength of English contractors. On the other hand, English manufacturers ought not to assume that the direct competition which the Westinghouse Company will be able to bring into the field will not be a serious one, the reputation of the company alone would secure them a large business, and the fact that they start out with an established connection makes the company all the more formidable. Although Americans will be largely, if not solely, employed in the direction of this large business, it possesses the advantage of a British directorate, and British capital will supply the sinews of war. The strength of the position of the Westinghouse Company will be largely reinforced by the American house, which will in all matters help its English offshoot. From a spectator's point of view it will be interesting to watch the growth of this American factory—for such, in fact, it is—and notice in what direction their methods are superior to our own. That they will involve great departures from ordinary English practice none could deny, and in that respect it may serve to stimulate English manufacturers to adopt newer methods where they are found to be superior to theirs. It is fully expected that the improved system of manufacture which the company will import from America will enable them to increase the individual output, and that alone ought to determine home manufacturers to introduce fast-running tools, without which it is impossible to obtain that rapid output of work which is so essential in these days of high pressure. Probably existing manufacturers will view the impending competition with a certain amount of equanimity; their shops are full of work, and it is unlikely that any new competitor will, for some time to come, exercise much effect on their business; moreover, there is every probability that the boom in electrical affairs may continue for several years. But there is bound to be eventually a falling off in the demand, and it is during periods of depression, and when orders are few, that superior organisation and more economical methods of production begin to tell. If the new company realises expectations, it ought to show to a marked degree the advantage of manufacturing on a large scale. How far the Westinghouse methods are superior to our own remains to be seen.

It would be wrong to regard the British Westinghouse Company in a hostile spirit; even if it were more foreign in character one could hardly wish it otherwise than a permanent success. It enters the electrical field at a time when the demand is greater than the supply; it will supply machinery of undoubted excellence, and its affairs will be managed by men of experience. Under those conditions it is difficult to see why it should fail.

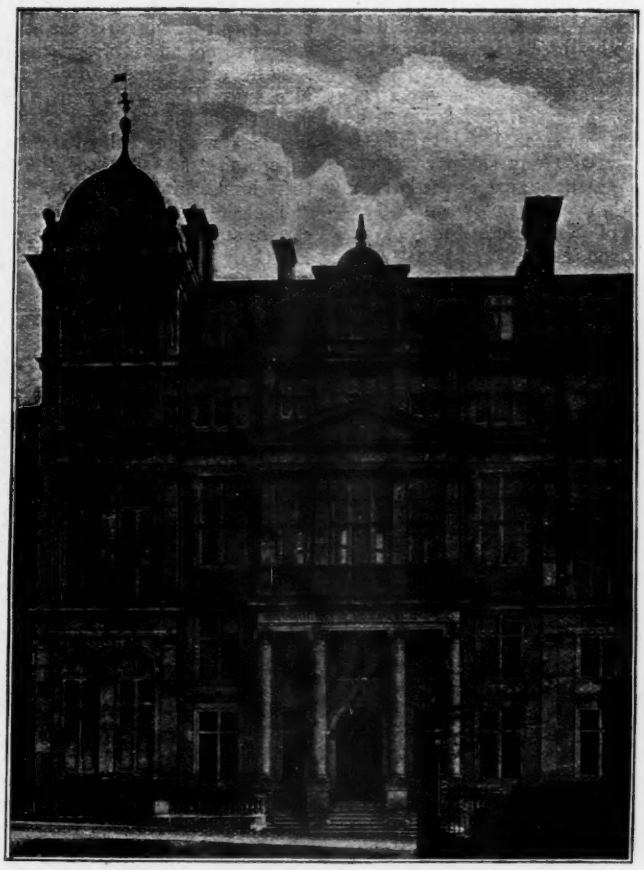
INSTITUTION OF MECHANICAL ENGINEERS.

The Institution of Mechanical Engineers entered into possession of its new home at Storey's Gate on Tuesday, May 16th, an event marking the commencement of a most important era in the history of the Institution. Hitherto the meetings of the Institution have been held by the kindness of the Council of the Institution of Civil Engineers at the Institution, 25, Great George Street, and the members have always felt that such a condition of things was hardly consistent with the rapidly increasing growth and importance of the Institution of Mechanical Engineers.

The design of the new buildings, which were formally opened on May 16th, received the most careful attention of the committee appointed by the Council for the purpose of settling such details; in fact, it may be stated that the labours of this committee have extended over nearly five years. The result, however, cannot fail to reflect great credit upon the individual members in their several capacities, each and every one of whom has spared neither time nor trouble, and has given his best attention to the thousand and one matters that came under consideration from time to time.

The building has an extremely handsome exterior, the façade being of Portland stone and red brick. The architect, Mr. Basil Slade, is greatly to be congratulated upon the result of his labour, and a brief extract from his own description of the building will, perhaps, best convey an accurate idea to the minds of our readers:—

"The entrance-hall and staircase are treated with Hungarian oak panelings, floorings, arcadings, balusters, newels, &c., French polished, and surmounted by plain Persian red walls and enriched ceilings.



Institution of Mechanical Engineers.

"Immediately opposite the entrance is the main doorway into the lecture theatre. This apartment has a Georgian ceiling with central glass dome, from which the room is lighted by day, and by night from a cluster of incandescent electric hanging lamps. The floor is constructed of movable platforms, which can be arranged to form terraces or a level floor, as desired.

"The ornamental ceiling is hung from the top and free from walls, and has a bold cove, behind which the wall-diagram rollers are hidden. It is trusted this arrangement of ceiling will give good acoustic results, and prevent any echo.

"On this floor, approached by a broad corridor, is the council chamber, a room treated with a more Jacobean freedom, with an oaken ribbed star pattern ceiling, and a bold cove for the cornice.

"On the entresol floor below is found the marble tea room or withdrawing room, running under the full length of the entrance hall. This room has been lined and decorated with costly marbles throughout; floors, walls, arcadings, and access staircases have been treated with both new and rare stones. The treatment is of latter date, in style following the Italian. The pilasters are antique sienna with statuary white caps and bases; the surbase is of dark dove with dado of cippolino and verte antique plinth. The panels are picked Mexican onyx, arranged to show the veining to best advantage, with delicate outline or border of pale dove with pavonazzi ground; the whole surmounted with a light statuary moulding and cippolino frieze.

"The ceiling is kept simple in design, with a few lines of gold to enhance the contract of the richly-coloured walls. The flooring is of piastraccia and dark grande antique squares.

"The tea room is served by a kitchen and pantry adjoining.

"On the same floor is to be found the principal lavatory, also treated in marbles, teaks, &c.

"The space under the lecture hall is occupied by two floors of very extensive area with annexes for the storage of 'proceedings' and other papers, amply large enough to provide accommodation for many years to come.

"On the basement floor are to be found the boiler room, ventilation ducts, and general electrical and mechanical accessories.

"Reascending the stairs, to above the entrance hall, is found the reading and smoking room — a room all in white of a simple Georgian character. On the same floor are the secretarial offices and galleries of the lecture hall.

"The fine and light hand-wrought iron work to the staircase and lift shaft deserves special notice.

"The whole of the floor above is occupied with the library, a lofty apartment with annexes and book-galleries. A bold cove and pendative ceiling is brought forward over the book-cases, giving the appearance of the books being recessed in the walls.

"The library is treated in the Elizabethan style, Hungarian picked oak being used throughout. The upper gallery is supported by bold cantilever oak modillions and Ionic columns and caps standing on a table-height shelf.

"Bastard statuary pilasters, an oaken impost, and arcades separate the main library from the annexes.

"The remainder of the building is occupied with offices for the staff, a room for the meetings of graduates, spacious drawing and diagram rooms, and apartments for the housekeeper.

"The principal rooms are ventilated on the plenum system. The fresh air is drawn by an electrically-driven fan, 4 feet diameter, from the north area in the park, and cleansed over fibre screens automatically washed with water, then passed over a radiation coil and along a duct up to the various apartments, whence the vitiated air is forced up vents to the top of the building."

The lecture hall and its equipment have, perhaps, received more attention and consideration than any other part of the building. Of course, in a sense, the success of such an Insti-

tution building is conditioned by the character of the lecture hall. It is here that the main business of the Institution is transacted, and no attractions in other parts of the building can possibly atone for bad acoustics, indifferent lighting, or inconvenient equipment in the lecture hall.

Perhaps the most novel feature is the introduction of movable platforms composing the floor of the hall. This idea, we believe, originated with Mr. W. H. Maw, chairman of the House Committee. By this means a level floor or a floor rising in tiers, can be arranged at will. As far as our knowledge goes, such an arrangement has never before been introduced in a lecture hall.

The acoustic property is excellent, it being an extremely easy room to speak in, and entirely free from echo. A gallery runs the whole width of the room at the back, and affords accommodation for a lantern by means of which views of all descriptions can be thrown upon the screen. Around three sides of the room, wall diagram rollers are fitted high up behind the cove, thus being entirely out of sight when not required. The hall is lighted entirely from the central octagonal glass dome, eight 100-candle-power incandescent lamps enclosed in holophane globes, being suspended one from each angle. The drop has been calculated so as to light the whole of the beautiful Georgian ceiling, and yet not extend below the sight line of members in the gallery. Thus any member in any part of the room can see any diagram with equal facility. The effect of the holophane globe is to diffuse the light and entirely do away with any sharp shadows. Two sets of two-way switches are fitted, one in the lecture hall and one in the gallery within convenient reach of the lantern operator, and by means of an electric bell fitted with plug attachment under the table on the platform, signals can be transmitted to the lantern operator in the case of a paper illustrated by slides according to a pre-arranged signal, thus lending perfect smoothness to the alternation of the views as the paper proceeds. By means of the two-way switches, it is possible to turn the lights on or off either from the gallery or from the lecture hall floor. In addition to this, a double-pole switch is fitted in the gallery by means of which the lantern operator can turn off all the eight lights and turn them on at will. A 40-ampere plug protected by a double-pole switch is also fitted in the gallery for use with the electric lantern or for driving models or other gear; about 10 H.P. can be taken from this plug. A similar plug protected in a similar manner is fitted behind the lecture table on the platform for a similar purpose.

Throughout the building clock faces have been fitted, the hands of which are actuated by electricity from a master clock in the basement. The hands are moved forward every half minute simultaneously all over the building. The clocks were erected by Messrs. The Synchronome Company, Limited.

The building is fitted with two lifts, one for passengers and the other for books, &c. Both are operated by electricity and were erected by the Otis Elevator Company. All the ventilating fans throughout the building are driven by electric motors; in fact, with the exception of the heating, it may be said that electricity has been employed for every purpose usually required in such a building. The wiring was carried out upon the continuous conduit principle by Mr. V. G. Middleton, the contractor selected to execute the work. The principle of sub-division has been rigidly adhered to, the lights on each floor being served by a separate pair of mains terminating at the distributing fuse-board from which circuits are taken off through a fuse on each pole to feed groups of not more than eight lamps each. Separate mains have been run for all motive power, and special precautions have been taken in the design of the fuse-boards in order to suit the higher voltage adopted. The main switch and distributing boards are arranged with a view to a possible extension by the Supply Company of the principle of higher voltage. In regard to the fittings, the aim has been to secure efficiency of lighting combined with simplicity and grace of design. The Florentine bronze pendants in the entrance hall and reading room are from designs by Messrs. Hardman & Powell, who also manufactured the brackets for the staircases and library. These latter were designed by Mr. B. Slade, the architect of the building, and have already evoked much attention on account of their simple but attractive design.

The superficial area of the site available rendered a number of floors necessary to obtain the required space. At the same time little fault is to be found with the size of the lecture hall, which is an extremely fine room, 60 feet long by 40 feet broad by 40 feet high. The lecture hall, Council room, secretary's office, and other important parts of the building, are connected by a complete system of speaking tubes and electric bells. At each entrance also there is an electric alarm bell which is to be used in case of fire or other urgent necessity, each push communicating with and ringing simultaneously gongs erected in various parts of the building so as to ensure someone's attention being attracted in the event of the alarm bell being used.

A complete fire service has been fitted up by Messrs. Merryweather.

Of a building such as this it is impossible to write adequately in a few lines. It represents the result of years of thought on the part of a large number of co-operating experts, each skilled in his own particular subject. The system of ventilation, the marble design, the wood carving, the system of heating, &c., each might well have an article devoted to it since each represents the highest development of its own particular science at the present date. However, space will not admit of our entering into details at length in these matters. Those who wish to study the new Institution of Mechanical Engineers, which in all its mechanical appliances is worthy of the traditions of the Institution, should become members without delay in order to have ample time and opportunity for study of the various mechanical devices there brought into operation.

The electric lighting and other electric equipment were carried out under the design and superintendence of Mr. Ed. C. de Segundo, A.M.I.C.E.

INDISPENSABLE ACCESSORIES OF ELECTRIC TRACTION.

By HENRY E. P. COTTRELL, A.M.I.C.E.

(*Continued from Vol.* 44, *page* 1053.)

Roller Bearings.

The importance of diminishing the friction between the axles and the bearings in the journal boxes, is self-evident, especially when starting a car from rest, where to overcome the inertia, the expenditure of current is most wasteful at the ordinary voltage. The difference between rolling and rubbing friction, even with polished surfaces, is exemplified by the rate of inclination of the planes on which a roller and a flat die of the same weight and depth will respectively start moving from rest. A rate of inclination of 1 in 200 will produce motion in the former, while it requires 1 in 14 to do so in the latter, the ratio per cent. being as 1 to 14; or, in other words, the resistance to motion produced by rolling friction is but one-fourteenth of that of rubbing friction. Ball bearings in case of heavily loaded journals are unsuitable owing to the fact that the load is carried on an interrupted line of points or on several separate parallel lines of the same character. The coefficient of rolling friction within certain limits increases inversely as the diameter of the wheel or roller, that is, the smaller the diameter the greater the amount of friction generated between the surfaces in contact. With ball bearings presenting an interrupted line of points the greater the diameter of the balls the greater the distance between the points of support and the smaller the bearing surface of the journals. To increase the amount of bearing surface, the balls have to be decreased in diameter and the number of parallel lines forming the ball path increased, the result being a heavy proportional increase in the journal friction and an undesirable increase in the width of the journal boxes to hold the extended ball paths. The great advantage afforded by substituting a roller of the same diameter for a ball lies in the fact that with a prescribed minimum journal bearing surface the width of the journal boxes with rollers can be made about the fortieth part of what balls would require. A roller path like a ball path presents along the width of the journal boxes a series of

continuous lines instead of interrupted lines of points as the bearing surfaces between the journals and the axle boxes. In practice, the actual contact surface of a 1-inch ball in a loaded bearing is about one-fortieth of the actual contact surface of a cylinder of the same diameter 1 inch in length.

Ball bearings for cycle purposes, and for all machinery where the load on the bearings is comparatively small, will undoubtedly hold their own and leave little to be desired in the way of improvement, but there can be no question as to the superiority of roller bearings where the load is great, in respect to compactness and diminution in the wear and tear of the journal box liners and the journals themselves.

The rollers or cylinders used in bearings may be either solid and rigid, or elastic and flexible. The first type has been manufactured in Great Britain for some years by the Roller Bearings Company, Limited, and has met with considerable success and favour on railways and tramways both in the United Kingdom, the Continent, and the Colonies. These rollers are made like the balls for ball bearings, of hardened and tempered crucible steel ground down to the utmost perfection of surface and dimensions. They are controlled and held in correct relative position by a floating cage; the axle box liners are also made of steel hardened and finished to the greatest accuracy. The conditions precedent to satisfactory working in these bearings are that all the rollers in the path shall be of exactly the same size, perfectly finished, and kept absolutely parallel with the journal or shaft, and the latter parallel with the liners of the axle box. These conditions are difficult to ensure in tramway practice where the unavoidable unevenness of the road bed and the constant shifting of the load in the car causes the pressure between the journal and the boxes to be constantly varying in amount and distribution, disturbing the position of the rollers in the floating cage. Hence the rigid and solid roller bearing is better fitted for fixed machinery

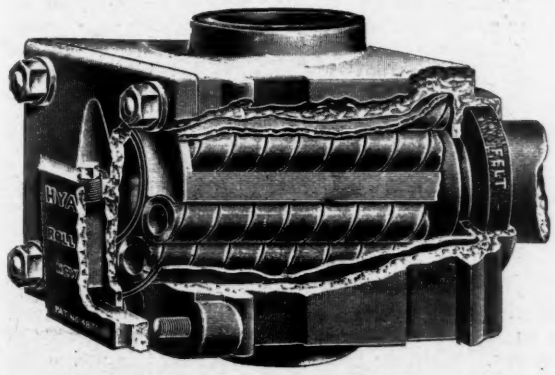


Fig. 47.—Axle Box for Electric Tramway Car.

than for electric traction purposes. On the other hand, the elastic and flexible roller is exactly what is required. In this type (fig. 47) the rollers are formed of a cylindrically coiled steel ribbon, and they are, therefore, elastic in the direction of their diameter and flexible longitudinally, and are able to readily adapt themselves to all the varying conditions of pressure between the journals and the box liners. These coiled rollers are made of untempered open hearth steel, and do not require the accurate finish of the solid roller. Neither do the journals or the box liners require special finish or accuracy in their construction. They are held in position by a yoke guide of gunmetal; the liners are made of sheet steel with a spiral joint, and a similar sleeve is slipped over the axle, the rollers travelling between the two. The sleeves obviate the necessity for specially finished surfaces on journals or box, and form a wearing surface much more durable than wrought or cast-iron. These bearings are known as the Hyatt roller bearings after the name of the inventor.

The Franklin Institute has lately carried out some conclusive experiments to test the relative merits of solid and flexible roller bearings, the latter being helically coiled and elastic, both transversely and longitudinally, of the Hyatt roller type. The frictional resistance of the two types of bearing was carefully measured and compared. The rollers were 11 inches long and ¾-inch in diameter, and four of each type were used. Tested between smooth plates the flexible roller bearings showed a frictional resistance amounting to only 48 per cent. of that of the solid rollers, and when between rough plates the average coefficient amounted to 77 per cent. of the same.

The special advantages of roller bearings for electric traction purposes, as compared with ordinary brasses, may be summarised as follows:—

1. Lubrication more thorough and requiring less attention and less frequent renewal.
2. Bearings more cleanly in operation, and wear and tear and risk of heating reduced to a minimum, &c.
3. Power required to start a car reduced, in some cases, to one-tenth, and that required to keep it in motion to three-quarters.

The importance of the third advantage enumerated above in electric traction cannot be over-estimated, as by this means the heavy strain on the motor at starting, which is so often the cause of burned out armatures, is relieved; less power is wasted on the rheostat, and the car is started with less shock and jerk to the passengers. The economy in power effected by the use of these bearings may often save overloading a central station or a line wire, and thus avoid costly burn outs or the enforced substitution of line wire of larger sectional area at a comparatively earlier date than ought to be necessary on a given road. These bearings have a record of over 150,000 miles per set without repairs, and with this record it was found that neither rollers nor bearings had reached their limit of durability, the wear shown being very slight.

Life Guards.

Although the fencing of railways in the United Kingdom has almost entirely done away with the necessity for cow catchers in front of the engines, the guards in front of the wheel being as a rule amply sufficient to remove all accidental obstructions, while in horse tramways the pace is so limited that it is generally easily possible to avoid running over anything that may get in the way, the case is quite different when we come to electric tramways. Here the speeds are comparable to railway speeds, and it would often be impossible to draw up in time to avoid running over a human being or an animal who accidentally or designedly got suddenly in the way. It is most important both for safety and for humanitarian reasons to provide a means of preventing any living obstruction from passing beneath the wheels if it should happen to be knocked down by a motor car or be lying in its way across the track. An adjunct of the character of a cow catcher would no doubt save the car but it would inevitably seriously injure the obstruction. To avoid this the life guards must be spring balanced with the outer edge close to the rails, and possess an elastic platform of sufficient area to support and carry the obstruction till the car can be brought to a standstill. The Peckham adjustable life and wheel guard, of which fig. 48 gives a general view,

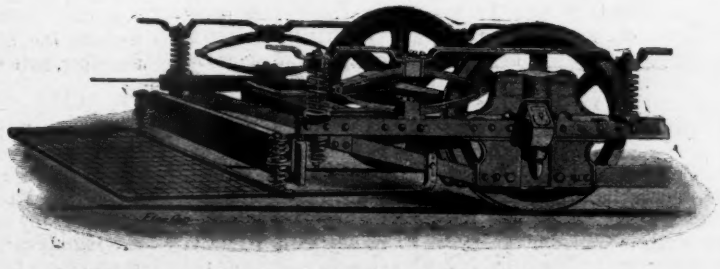


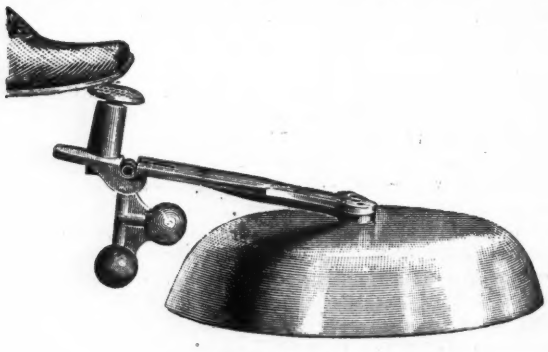
Fig. 48.

meets the requirements indicated above most satisfactorily. The rectangular frame carrying a netting has two arms which are bolted to the lower frame of the truck truss as shown in the figure, and is supported about half way along its length by a pair of double springs attached to the end of

the cantilever framing. These double springs allow the fender to move up and down with sufficient freedom to adjust itself to any weight it may carry, and they also absorb and quickly do away with oscillations which might cripple the fender by bringing it into repeated contact with the road or through throwing off anything carried on the fender. The outer edge of this is carried low, but the spring arrangement enables it to lift automatically over any small inequalities of the road and to depress easily to meet and catch up out of the way of the wheels any obstruction lying on the road. This combined life and wheel guard is strong, light, elastic, and easy of adjustment, and can be carried at any desired height above the rails, and being placed in close proximity to the wheels, does not come too soon into operation, and hence allows of considerable reduction of speed before obstructions are struck, lifted, and carried forward by the cars.

Gongs.

In the old horse car the gong is used simply for notifying the driver when to stop and drive on, or, in other words, for the passenger's benefit, obstructing traffic or persons, being warned by the driver's whistle, but in electric cars the whistle is no longer sufficient for the latter purpose, and a foot gong has to take its place. The motorman requires a means of unequivocally notifying the approach of the car at a much greater distance than is the case in the horse cars, and the steam whistle not being available, the foot gong has provided the requisite means of doing this. These gongs have to be actuated by the foot for the same reason as the sand box has to be worked in this way, because the motorman's hands and attention are required and occupied in other indispensable ways. Fig. 49 shows



Foot Gong.
Fig. 49.

the arrangement and action of such a gong, as manufactured by the Ohio Brass Company.

Track Scrapers.

No one who has observed the way in which the grooves in the rail heads on horse tramways are cleared, by running a long deep shovel with a projecting depressed lip along the rails, a man armed with this weapon at the end of a long handle, working along each rail in succession, can have done otherwise than marvel that such a primitive process could have continued so long in use. The speed and other conditions of working tramlines by electricity render it imperative to substitute a more reasonable system in their case, and make it indispensable to add an efficient scraper to each car end as a permanent adjunct of its equipment. The leading scraper is the one operated in every case, and effective traction is secured by its use whenever the rails are greasy and the grooves choked by dirt, mud, snow or ice, the scraper cleaning the rail thoroughly before the wheels pass over them. The principle on which these scrapers are constructed can be readily gathered from the accompanying figure (fig. 50), where it will be seen that the scrapers consist of plates with a projection fitting into the rail groove fixed at an angle to the axis of the truck so as to self clear the materials scraped from the track. These plates are borne upon arms fastened to a bar working in two sockets in the truck frame, a plate is fixed vertically at the centre of this bar, to the ends of which the ends of a chain are fastened, which run round a worm at the bottom of a vertical ratchet post moved by an ordinary ratchet brake handle. The whole arrangement is simple, light, effective and inexpensive.

Track Brush.

The necessary complement of the track scraper is the track brush. This finally clears away all the mud, &c., dislodged

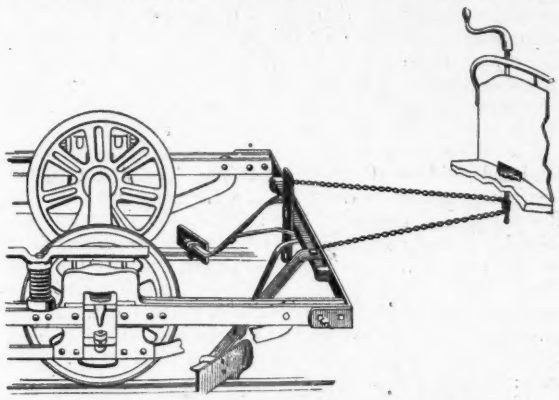


Fig. 50.—Peckham Patent Track Scraper.

by the scraper which would otherwise once more become spread over the rails and fill up the flange groove, and thus interfere with the proper propulsion of the cars. The track brushes are fitted to the guard boards at either end of the car with sufficient clearance from the rail when thrown out of work to prevent the wire heads from touching. There are two forms of holders in use, both produced by the Ohio Brass Company, fig. 51, known as the "adjustable," and

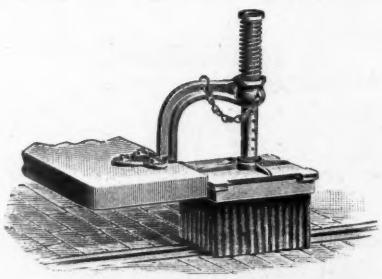


Fig. 51.—Track Brush.

the other as the "reversible and adjustable," both being fitted to either vertical, horizontal or inclined guard boards as required. With the first the brush is placed in position by depressing the pipe standard, compressing the spring, and inserting a cotter into a hole in the standard at the required height, the brush being disengaged by the action of the spring when the cotter is removed. In the second form the height of the brush is not adjustable and the disengaging is effected by throwing up the holder, the engaging being automatic on the holder being thrown down. The sole advantage of this form lies in the brushes being examinable without removal, but their not being adjustable, as in the first form, is a decided drawback. These adjustable track brush-holders increase the life of the brushes some 500 per cent., and, therefore, save expense and trouble.

Sand Box.

The accessory which follows next upon the track scraper in importance as an economiser of power and an improver of tractive efficiency is the sand box. To be efficient this must be arranged so as to be readily brought into use without entailing any distraction of the motorman's attention from driving his car, and must, therefore, be actuated by a movement of his foot. The internal construction must be such that the sand should never cake in the tapering funnel and shall always run easily and freely. The accompanying fig. 52 shows a type of sand box which meets both these requirements very satisfactorily. It is actuated by the pressure of the motorman's foot on the projecting stud, and the wedge piece vertically fixed above the valve effectually prevents the sand from caking.

HEATERS.

Although in the Southern portion, at least, of the British Isles the question of heating tramway cars can practically be ignored, for it is only once in many years that a winter occurs

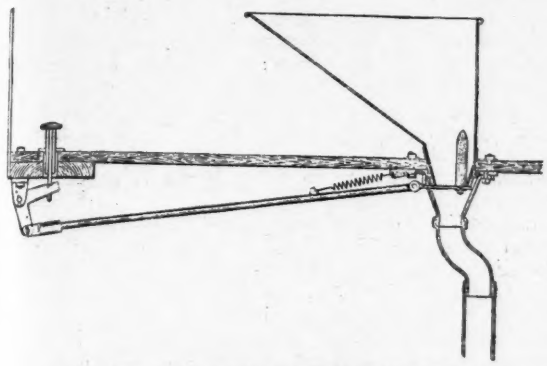


FIG. 52.—DEWITT "COMMON SENSE" SAND BOX.

when heating is required, still in the Northern parts of the same Island winter can be depended upon as a yearly event, and not a mere accident, and there the question of the suitable form of car heating is one of considerable interest to the public travelling on electric tramways. Just as on railways the only satisfactory method of heating is by steam, so on electric tramways the only satisfactory method is by electricity. In both cases the propelling power is thus utilised for heating purposes. In the United States the heating of railway carriages is generally effected by a closed stove burning anthracite or coke placed in one corner of the car, and to this stove can be traced some of the most appalling consequences of railway accidents. On the other hand, on British railways the chemical or hot-water foot warmer is generally the safe but wholly inefficient medium for conveying warmth to the feet of long journey passengers. Both of these methods of heating have found their application on tramcars, electric and otherwise, but neither can be called a success. The stove takes up too much room and requires more attention than the employés can find time to bestow, and the foot-warmer is even worse in a tramcar than in a railway carriage, as it cools far quicker and cannot so readily be replenished or exchanged. What is required in a heater to make it efficient for tramway purposes is that it should be: (1) light and compact, (2) easily manipulated by motorman or conductor, (3) not subject to getting out of order, (4) giving a uniformly distributed heat, which can readily be regulated between certain limits, (5) applicable without structural alterations to any form of car body.

(*To be continued.*)

REVIEWS.

Unités Electriques Absolues. Leçons Professées à la Sorbonne. Par M. G. LIPPMANN, Membre de l'Institut. Rédigées par M. A. BERGET, Docteur ès Sciences. Paris: Georges Carré et C. Naud. 1899.

This reprint of a course of professional lectures at the Sorbonne is a more important piece of work than its modest title indicates. It is a clear, consecutive introduction to the electrical argument of the ether. The book opens with an introduction dealing with physical dimensions; then follows a section of five chapters on the electrostatic system, leading to a statement of the circumstances in which energy is stored in the charges, and of the electrostatic system of dimensions. A section of five chapters on the magnetic system is succeeded by a chapter on the relation between the two systems of units, the meaning of the quantity v, and the different methods for its determination. The theorem of Kirchhoff that a disturbance travels along a conductor of small resistance with the velocity v, introduces the conception of v as the velocity of transmission through a medium, and terminates the section. A chapter follows, giving a brief statement—too brief—of Maxwell's theory of the mode of transmission of the simplest electrical disturbance—a plane wave—in a non-conducting medium, and some account of the identification of the corresponding speed with the known velocity of light. A final chapter on the two principles of the conservation of energy and electricity and their application to reasoning on the properties of matter concludes the argument. An appendix describing an ingenious mercurial galvanometer is like the seal of a document; it identifies the writer, but adds nothing to the substance of the writing.

M. Lippmann's treatment of the subject is that of a physicist, not of a mathematician. Much of his argument is, of course, stated in symbolic form for reasons of brevity, but there is very little which could not be clearly given in words. The object set out in the preface is conspicuous before the author's mind at every point. He desires to state briefly, lucidly, cogently, the experimental facts, and the course of reasoning that have established the accepted theory of electrical action, and he recognises that neither exact statement, nor clear apprehension of the argument, requires the use of the specialised logical processes of higher mathematics. Simplicity of treatment is the note of the book.

Pourtant la complexité de cet ensemble n'est qu'apparente. Les unités absolues ne servent qu'à simplifier les trois équations élémentaires qui régissent les phénomènes de l'attraction électrique, de l'électromagnétisme, et de l'induction. Ce sont ces trois équations élémentaires qui, seules, sont mises en œuvre dans tous les problèmes, sans que l'on ait à faire intervenir de théories ou d'hypothèses supplémentaires. Si l'édifice est grand, la charpente en est simple: c'est ce que j'ai cherché à mettre en évidence dans ces Leçons. On n'y trouvera donc qu'une analyse limitée au strict nécessaire, et que des descriptions de méthodes et d'appareils réduits presque à leurs principes.

In several ways M. Lippmann's treatment of the subject differs from that of the English books. The electrical potential at a point is defined in the first place as a geometrical function of the distances from the charges, not as the measure of the energy of a charge placed there; and care is taken not to suggest any similarity between electrical energy and a force function. The student's attention is drawn directly to the analogy of the movement of electricity with that of heat, and away from any analogy with the movement of matter. The question between the two modes of treatment is one of educational convenience, and the success of the teaching is the critical test. M. Lippmann's method seems to have the disadvantage that the student's previous familiarity with the notions of mechanics and attractions, which though difficult must of necessity be acquired, is not made much use of. On the other hand, it leads to the exceedingly elegant treatment of problems by means of reversible and irreversible cycles, similar to those used in the theory of heat. We have not seen this interesting treatment used in any other educational work on electricity. On the whole, M. Lippmann seems to be quite right. The difference between the flow of a frictionless massless fluid, such as a student must inevitably, for the present, picture in his mind electricity to be, and the movements of rigid bodies, is so great that the student may lose more time than he gains by learning to extend, to the properties of electricity, the dynamical conceptions obtained from the mechanics of rigid bodies. At the same time, M. Lippmann is careful to point out the great distinction between the modes of the flow of heat and electricity along conductors, and gives Kirchhoff's proof, that in a steady flow of electricity there is no charge in the mass of the conductor, an argument that leads inevitably to the corollary that the flow of energy takes place in the dielectric.

Among points that have attracted our notice in reading this book we may mention Prof. Lippmann's absolute electrometer, the measurement of resistance in absolute measure in electrostatic units, and the very clear account of seven different ways of measuring it in electro-magnetic units. The representation of the couple produced by an element of current on a magnetic pole, and the proof that it vanishes with a closed circuit, is an elegant geometrical proposition, but exhibits forcibly the artificiality of the whole conception of single poles. We note an error here: the angle, θ, on which the argument turns is the complement of that defined. In Kirchhoff's important theorem of the propagation of an electric disturbance along a wire, v is introduced in a way

that is unintelligible without further explanation, but the editor has probably omitted matter that the professor would have introduced into a verbal discourse.

The final chapter on the principles of conservation of energy and electricity is of great interest, as employing a mode of reasoning not commonly found in educational works on the subject.

We have given to the notice of this work more than usual space, because, more than any other comparatively elementary book we know, it is cast in the mould of logical sequence, not of the historical succession of discovery. M. Lippmann has extracted from the material of elementary works on electricity only what is necessary for a statement of his theory, and from the two primary facts, the mutual actions of two charges at rest and of two charges in motion, giving the electrostatic and the electro-magnetic forces, he advances up to the theory of the propagation of electrical disturbance in a dielectric, and places the student in a secure position for further advance. The introduction of the idea of a magnetic pole, an idea connected only with the properties of iron and quite superfluous in the subject of electro-dynamics, is rendered inevitable by the definitions of the units. We greatly appreciate a book which places the electrical argument so clearly before students, free from the symbolic haze so repulsive to some, and from the mass of experimental detail not to be assimilated by others.

En resumé, je n'ai pas songé à condenser, en un court volume la matière de plusieurs ouvrages spéciaux. Je désire seulement avoir rendu l'étude de l'Electricité plus claire pour les jeunes physiciens, peut-être aussi pour quelques mathématiciens curieux: ceux là n'ignorent pas combien il importe de savoir, en Physique Mathématique, ce que l'on met dans ses équations.

Municipal Electricity Supply. By A. H. Gibbings.

We have received a copy of the above publication, which deals almost solely with the "Commercial and Business Aspects" of municipal supply. In the preface the author says:—"My experience teaches me that it is the want of a *full, exact, and comprehensive knowledge*, which accounts in too many cases for a hesitating and unbusinesslike policy on the part of electricity committees. I have, therefore, endeavoured to present the matter in such a form, that the ordinary business man may gain *some idea* of the peculiar conditions which render the supply of electric energy different from that of most marketable commodities." (Italics ours.) The author is too modest, for if his book will not do more than give "*some idea*" to his non-technical readers who possess business instincts, they must be very dense indeed, and we can hardly see the object of writing a book with the intention of giving "some idea," when a "full, exact, and comprehensive knowledge" is said to be necessary, except upon the socialistic principle of a gradual education, so that unborn generations may reap the full advantage of hereditary training.

The book is divided into 12 sections. Section I. deals with Committees of Management, and is practically a *résumé* of a paper read by the author at the last Convention of the Municipal Electrical Association. An extract of three or four lines will explain the objects of the section:—"In a few years the necessity will arise in all but the very smallest townships to form numerous small sub-committees, each of which will be separately responsible to a main or general committee." This is a debatable subject, and amongst municipal engineers opinions are divided, some holding the view that supervision of detail by committees or sub-committees is even now frequently overdone. With this view we are inclined to agree, when we see committees taking a tour all over Great Britain, or, perhaps, the Continent, in order to settle a point upon which their engineer should be quite competent to advise them. Directors of large companies leave such matters of detail to their officers, and wisely so, we think.

Section II. deals with the wiring of premises by the local authority. Quoting the Corporation of Bolton, who do their own wiring, it says:—"Another advantage gained by doing wiring is, that should anything go wrong, our customers have only one party to deal with, viz., the Corporation." From the customer's point of view this is doubtless an advantage, but we should hardly think it is so to the Corporation.

Section III. deals with the various methods of charging for energy.

Section IV. refers to electric motive power, and shows the advantages to be derived both by the user and the undertaker by its extended adoption. In replying to the objection that in the winter the motor load overlaps the lighting load, the author says:—"A certain proportion of the power for motors is bound to overlap the maximum of the lighting load, but the greater proportion undoubtedly occurs before 5 p.m. throughout the year." As in London in foggy weather it is frequently quite dark at 4 p.m. or earlier, the overlap may be serious if motive power to any great extent is demanded.

Section V. is a detailed description of the system of "hiring out of motors, arc lamps, &c.," as adopted by the Bradford Corporation, including the book-keeping with book heading report forms, invoices, &c., complete. In this section also appears "Directions to be observed to ensure the safe and satisfactory working of Electric Motors," including amongst other directions the following:—"The motor must never be started with load on," and "it must not be used until full speed has been attained." Both very desirable precautions, but what becomes of the objection so frequently urged against the use of alternating current motors, viz, that they cannot be started on load?

Section VI. is a dissertation on the advantages of "free wiring" when conducted by a well-known "Free Wiring Company," and we should think the remainder of the numerous advertisers in the book will be justly jealous when they discover that this firm practically monopolises a whole section of nearly 17 pages.

Section VII. deals with and describes the merits of the system of free supply of incandescent lamps in vogue at Bradford. The author points out that the terms "free wiring" and "free supply of lamps" are incorrect, but are used for convenience. As a matter of fact, the lamps are "given away" very much as the teapot and other things are "given away with a pound of tea."

Section VIII. describes the method of supply by means of "penny-in-the-slot," or prepayment meters, and goes considerably beyond the alleged object of the book in describing at length the detail construction of different meters, and one case apparently consists of the greater part of the patent specification, including the detail drawings.

In Section IX., on side-street lighting, the author waxes justly enthusiastic as regards public lighting by electricity generally, and we cannot help admiring his confidence when he says: "It may be taken for granted that it has already been amply proved that arc lighting is the most satisfactory, the most economical, and, in fact, the only practically possible way of lighting the main streets of any town, and that all other methods will shortly become obsolete." The systems of lighting side streets by means of incandescent lamps, as adopted by Bradford, Brighton, Chelmsford, Hanley, Derby, Portsmouth, Taunton, and other places, are described, and a good case made out in their favour.

Section X. is headed, "Fitting up and Managing a Corporation Showroom," but consists chiefly of a list and particulars of the various causes of dissatisfaction of the public. The author in this section refers to the notable unreliability of fuses, and considers that a more desirable arrangement would be a maximum current automatic cut-out switch, which could be readily replaced by the consumer. We are of opinion, however, that if fuses are troublesome, automatic switches would be far more so, as the rush of current due to a momentary short has been known to knock over main cut-outs before the small single-lamp fuse could "go," thus putting a whole house in darkness where only one lamp would have been extinguished had the much-maligned "main fuse" been used instead.

Section XI. deals with extensions to outlying districts, and the last section describes various purposes for which electrical energy may be used. The book contains much that is of interest to municipal men, and should be the means, if read by members of committees, of giving them a far better idea of the commercial side of electricity supply than many of them now possess. At the same time, we are of opinion that much of the matter is irrelevant, and might with advantage have been omitted.

Dictionnaire Technique, Francais-Anglais, des outils et utensiles employés dans les métiers manuels, la petite industrie, le ménage, &c. By A. S. Lovendal. Paris: Boyveau et Chevillet.

This is a small collection of the names of tools used by French mechanics with English equivalents or translations, and contains many curious and unfamiliar terms. The tools referred to are exclusively those used in a few small manual trades, and the book would be useful rather to tool and hardware dealers than to engineers. The arrangement of matter of this kind is obviously rather difficult. The editor disposes the items in two ways. He collects together the names of all the different tools of one kind, where these are numerous, as in the case of files, of which more than 120 different sorts are named, and of pliers, about 100 different sorts; and collects together the names of tools used in each particular trade. This is probably convenient for persons who have some knowledge of the subject they are dealing with, but very inconvenient when that knowledge is absent. In the advertisement are mentioned several French tools with curious names, as instances of the difficulty of recognising such terms without a book of this kind. We wonder how many Englishmen would know the meaning of *Fer de moulure de doucine, Bigorne, Vastringue, Bedane.* The book should interest lexicographers.

CORRESPONDENCE.

The Price of Electrical Energy at Morecambe.

Referring to the notes on the above in last week's issue, I should like to point out that as Morecambe is quite a summer resort, many of the shops and restaurants, as well as the piers, &c., close during the winter season. The former are charged 5d. per unit, whereas the latter have had the charge increased to 7d. per unit.

I may mention that a firm of electrical contractors have been fitting up one of the piers since the beginning of the year. When nearly completed, the Pier Company are informed by the Council's engineer, who also is, or was, the Pier Company's consulting engineer, that the price to them would be 7d. per B.T.U. Subsequently we hear of the gas-fitters on the job.

Can the Council afford to lose such consumers? I hardly think so.

Their summer load corresponds exactly with the winter load of most inland towns, where there are similar consumers to the piers, &c., but up to the present I have not heard of any town increasing the price to such consumers 40 per cent. per unit, which, without doubt, is exorbitant.

Personally, I should advise the Council to adopt the "Wright" system of charging and equalise the above prices.

D. O. F.

July 12th, 1899.

Electrolytic Methods of Zinc Extraction.

My attention has been drawn to an article appearing in your issue of July 14th, entitled "The Electrolytic Methods of Zinc Extraction"; I should like to point out several errors occurring in the particulars given of my process. In the first place, the process has not been tried by the British Broken Hill Company in New South Wales; in the second, the works in Cornwall are about to be removed to near London, where the process will be worked on an extensive scale.

Shed. Cowper-Coles.

Westminster, *July 14th*, 1899.

I have read the above letter from Mr. Cowper-Coles with interest.

With reference to the first error, I may refer Mr. Cowper-Coles to the reports of the directors of the British Broken Hill Proprietary Company for the half-year ending December 31st, 1898, which contains the following statement:—

Mr. Cowper-Coles's inventions for extraction of zinc, while presenting many elements of ingenuity and promise, have disclosed anomalies, when tested on a commercial scale, which have not hitherto been remedied, and no other process has come under the observation of the directors which appears to answer their requirements.—*Times*, April 5th, 1899.

Whether the actual trials which led the directors to this decision were made in this country or in New South Wales, is certainly of secondary importance.

As regards the second error, I stated in my article that the Cowper-Coles zinc extraction process had been tried in Cornwall in the years 1897-98. Mr. Cowper-Coles now *confirms* this statement by the information that "the works in Cornwall are about to be removed to near London." Where is the error?

John B. C. Kershaw.

July 17th.

Disclaimer.

We notice in your issue of yesterday a report of the first meeting of creditors of J. C. N. Hilton, electrical engineer, of Trafalgar Works, Bow Common Lane. The debtor in his statement of affairs refers to his connection with the firm of Nalder & Hilton, Limited, whose business, he states, is now conducted by a receiver for debenture-holders. As the similarity of names may cause some confusion both to the trade and to the public, we think it only right to inform you that neither our company, nor any director, servant, or agent thereof, is, or ever has been, directly or indirectly connected with the firm of Nalder & Hilton, Limited, or the Nalder and Harrison Construction Syndicate mentioned by the said debtor.

We shall feel obliged if you kindly publish this letter.

Nalder Bros. & Thompson, Limited.
E. Thompson, *Managing Director.*

LEGAL.

Agents and Parliamentary Bills.

Before the Court of Referees at the House of Commons on July 11th, an interesting case arose as to the ability of a public company to withdraw the powers it had granted to its agent in the promotion of a Parliamentary Bill. The South Staffordshire Tramways Company are promoting a Bill in the present Session to empower them to lease their tramways to the British Electric Traction Company, by which the lines could be worked by electricity. This Bill had been approved at a Wharncliffe meeting of the company though three of the shareholders who dissented were now petitioning against the Bill. In their petition they were joined by about 20 other shareholders, and the *locus* of these was opposed by the company, though the *locus* of the original dissenting shareholders was necessarily allowed. But since the petition was presented the position has changed. A week ago the tramways company held an extraordinary general meeting at which it was decided that Messrs. W. and W. M. Bell should be appointed agents to their Bill in place of Messrs. Sherwood & Co., and that they should take such steps as they thought fit to withdraw the Bill or appear before the Committee.

Mr. Littler, Q.C. (instructed by Messrs. Bell) now appeared for the company, and said they did not propose to object to the *locus* of the petitioners.

Mr. Chandos Leigh, Q.C. (the Speaker's counsel) said, so far as that House was concerned, Messrs. Bell were not the agents of the promoters of the Bill. The rules of the House did not allow an agent to be changed without the consent of that agent, and Messrs. Sherwood had not consented.

Mr. Littler contended it was against the law of the country for any agent to act without the authority of his principal. No rules in the world could ever override that doctrine.

Mr. Chandos Leigh repeated that, so far as that House was concerned, there had been no change in the agents. The examiner, Mr. Somerset, had refused to allow any change in the name of the agents of the Bill, and Messrs. Bell had no power in the matter.

After some discussion, the Chairman said the Court thought the question between the two parties should be settled outside, and disallowed the *locus* of the petitioners.

Metropolitan Electric Supply Company, Limited, *v.* Armanni.

At Bow Street on July 17th, before Mr. Lushington, Luigi Armanni, mechanical and electrical engineer, of Warwick Court, Holborn, appeared to an adjourned summons charging him with feloniously abstracting and consuming electricity belonging to the Metropolitan Electric Supply Company, Limited, contrary to the Electric Lighting Act, 1882. Mr. R. D. Muir supported the summons on behalf of the

company; Mr. Lloyd Humphreys defended. In this case, which has been in progress since May 26th—this being the sixth hearing—it is alleged that the defendant, by making a connection between two fuse boxes in his installation, had thrown the meter out of circuit and thus prevented its registering the amount of electricity consumed.

Two expert witnesses were now called for the defence, who said that the suggested short circuit would, if it had existed, have been immediately detected by the company's wireman, and accounted for the small register of the meter by the fact that (possibly owing to the vibration caused by the mechanical work in progress) a screw in the meter had worked loose, which would at first cause it to register imperfectly, and did, in fact, eventually stop it altogether on June 27th.

Mr. Lushington said that the case was one for a jury, and committed the prisoner for trial, allowing bail in two sureties in £50 each.

Anglo-American Telegraph Company, Limited, v. Metropolitan Finance Corporation, Limited.

In the City of London Court on July 14th, the Anglo-American Telegraph Company, Limited, 26, Old Broad Street, sought to compel the Metropolitan Finance Corporation, Limited, Parliament Mansions, Victoria Street, to pay a sum of £8 10s. 6d. for transmitting cable messages to America.

Mr. T. H. Aldous (Messrs. Aldous & Welfare), solicitor for the plaintiffs, stated that in February Dr. Griffin, the chairman of the defendant corporation, asked the plaintiffs whether he might open an account with them, and send cables. They stated that he might, and cable messages were received from the defendants, one letter being written by the managing director of the company. Now the defendants wanted to say that the Doctor had sent the messages on his own account, and not on behalf of the company. The managing director, in answer to the summons, said the corporation had never sent cables through the plaintiffs, and they were in no way liable for what Dr. Griffin had chosen to do. The company had in no way been a party to the account sued for being incurred.

Mr. Commissioner Kerr said he would adjourn the case for Dr. Griffin to be added as co-defendant.

The Glasgow Telegraphs.

The Railway and Canal Commissioners—Lord Stormonth-Darling' Sir Frederick Peel and Viscount Cobham—sat in the High Court of Justiciary on July 11th and 12th, when the difference which had arisen between the Postmaster-General and the Corporation of Glasgow, on an application by the Postmaster to lay lines of telegraphs in certain streets in Glasgow, came under consideration. Evidence was led on both sides on July 11th, and Mr. Shaw, Q.C., had addressed the Commissioners on behalf of the Corporation when the Commissioners rose that day.

On the following day the Solicitor-General, on behalf of the Crown, said the Postmaster-General was there dealing with a body which had a very limited interest in the matter under consideration, because it had only an interest to this extent—the surface so far as that was to be used for purposes of ordinary traffic, and the subsoil so far as they required it for the placing of sewers or drains. But they had no other right at all—no right of proprietorship or any other right whatsoever—as construed in the case of the Glasgow Coal Exchange against the Glasgow City and District Railway. The question therefore came to be not between parties having private or proprietary interests, but between two bodies, the representatives of the public in two capacities—one the Postmaster-General, representing the whole public using the telegraphs or telephones, and in an especial degree representing the city of Glasgow, because they would necessarily use these telephones; and the other a body representing the same public, so far as Glasgow was concerned, having rights of passage over the streets. The question was as to how the interests of the public were to be represented, and there was a greater public interest represented by the Postmaster-General than by the Corporation of Glasgow. If compensation were to be given that was not one of the matters which the Commissioners should be asked to measure, but was a Lands Clause matter. The Corporation had only a right to keep these streets in order and to allow the people to travel on them. The public would travel just as before, and the drains and pipes would be there just as before. What, then, was the basis upon which the Corporation were to get pecuniary consideration? On the question of pecuniary consideration what were they to give the Postmaster-General? They didn't give any right. If they got their pipes accommodated they had no right in anything else. They had no right in the subsoil of the street except it was occupied by their pipes. They had no title to give, and their consent did not give the Postmaster-General any right, because, if any man had a right to the soil, the Postmaster-General had to pay him for that. The Corporation were not vested in that property, and they had no right, title or property in it at all. The basis of compensation, he maintained, completely failed, and the soil ground for the Postmaster-General being entitled to ask consent was just, because in 1863, when the consent was first stipulated for, the Court said that was a matter in which, in so far as the public interest was concerned, the body vested in the streets for public purposes was to be heard. It failed in every respect, in fact, in law, and in equity. Nothing was taken from the Corporation and nothing should be paid. Further, that was a thing that had never been done before. The Commissioners were asked to make an entirely new departure, and to impose pecuniary terms upon the Postmaster-General for matters which had been arranged with other towns without any such terms having been thought of. What was proposed to be done was all in the general interests of the community, for any alteration in the systems which would remove the chances of things going wrong tended to the general benefit of the community. He further submitted that the question of pecuniary terms was not competently before the Commissioners. The attempt of the Corporation to bring that in was an after-thought brought in after the difference had arisen and after the difference had been considered. The difference was constituted before any appeal was made to the Sheriff, and it was only that difference made to the Sheriff, and that difference only, which the Commissioners could determine. He demurred entirely to the view that that was done at the instance, or in the interests of the National Telephone Company. That had not been proved. If the Telephone Company had been at the back of the movement, he would have expected that the Telephone Company would have said to the Post Office: We applied for this underground system all over Glasgow, and you should do the same. Instead of that they had only a request by the Post Office for an underground service from one place to another. He submitted that the judgment of the Sheriff should be repeated, and consent given without conditions and terms.

Lord Stormonth-Darling said the Commissioners would take time to consider the question, and the decision would either be communicated in writing to the parties, or it might be delivered in Court before July 20th.

Holliday v. National Telephone Company.

The Court of Appeal on July 17th gave judgment in favour of a Mr. Holliday, who had brought an action for damages for personal injury against the National Telephone Company. Mr. Holliday was injured by the explosion of a benzoline lamp which scattered molten solder over him as he was passing a spot in Clapham where telephone wires were being laid down. In the City of London Court he was awarded damages, but in the Queen's Bench Division judgment went against him. The decision of the County Court was now restored.

PARLIAMENTARY COMMITTEES.

Bradford Tramways and Improvement Bill.

This Bill, which is promoted by the Corporation of Bradford, and which was originally opposed by the Corporation of Leeds, and the local authorities of Baildon and Shipley, and by other parties, and the object of which, amongst other things, is to construct effective tramways between Bradford and Leeds, and to secure the regulation of Baildon Moor, was down for hearing before a Committee of the House of Lords, presided over by Earl Egerton, on the 11th inst.

The opposition was, however, withdrawn, by agreement between the parties, and it was subsequently stated that the Bill would come before the Committee of the Earl of Morley (Chairman of Committees of the House of Lords) as an unopposed measure.

Salford Corporation Bill.

On July 12th the Police and Sanitary Committee of the House of Commons (presided over by Sir Stafford Northcote) considered the Salford Corporation Bill. This measure is a small omnibus Bill dealing with police and sanitary powers in general, and it also provides for powers in connection with the working of the tramways which are shortly to be acquired by the Salford Corporation and urban districts adjoining from the Manchester and District Carriage and Tramways Company. The Bill was opposed by the Manchester Ship Canal Company, the Lancashire and Yorkshire and the London and North-Western Railway Companies, and the Swinton and Pendlebury Urban District Councils.

Mr. Fitzgerald, in opening the case for the promoters, said that the lease of the tramways granted to the Manchester Carriage and Tramways Company would expire in 1901, and the Corporation intended, on the expiration of the lease, to work the trams themselves and convert them into electrical trams. Under the present Bill they took power to reconstruct the entire system. The opposition of the railway companies was as to certain lands which it was proposed to acquire in the vicinity of Exchange and Victoria stations, and they also desired that protection should be given them where the tramways crossed their bridges. The Swinton and Pendlebury Councils had arrived at an agreement with the Corporation as to the working of the trams, and they wished that agreement to be scheduled to the Bill. The Corporation did not object to this in principle, but difficulties were found to have arisen in Parliamentary practice. As to the Ship Canal Company's opposition, Mr. Fitzgerald pointed out that the company claimed that they would have to adjust their bridge in Trafford Road to such a nicety, and to take such care in accommodating the tramways, that the Corporation ought to pay for the necessary works and the signalling that would be required. The Corporation, on the other hand, said that they originally owned the whole of the rights of the road, and that the canal interfered with them, not they with it. He offered to pay the initial cost of the signalling apparatus, but the Canal Company must work it.

Evidence in support of the Corporation's case was led, and

Mr. Pember, Q.C., addressed the Committee on behalf of the Swinton and Pendlebury Councils, and the Committee intimated that they thought the agreement should be scheduled in the Bill.

The opposition of the Ship Canal was not finished when the Committee adjourned.

On the following day the first matter which came up for consideration by the Committee was the question of the bridge of the company over the canal at Trafford Road. The Corporation proposes to carry its tramway across this bridge, and the Ship Canal Company objected, unless all responsibility for the working of it was assumed by the Corporation. The latter offered to pay for the neces ary works to make the bridge suitable for carrying electric tramways, provided that the company would work and maintain the semaphores. The Committee thought this was a reasonable offer, and inserted a clause providing that the Corporation should pay for erecting the signalling apparatus, and that after it was erected the company should maintain it. Evidence was then taken on behalf of the London and North-Western Railway Company regarding the compulsory acquisition of land, and the Committee again adjourned.

BUSINESS NOTICES, &c.

The Electrical Company, Limited.—We understand that the Electrical Company, Limited, of 122—124, Charing Cross Road, W.C., has just filed its balance sheet, which shows results beyond all expectations. After writing off the stock considerably, and writing off the patents, fixtures, plant, &c., to 1s., the net profits amount to over £4,000. The directors, in view of these favourable results, recently resolved that the company should undertake large installations, particularly for transmission of power plants, of which they have several up to 500 H.P. in hand already, and for this reason the capital has been increased to £50,000. The Electrical Company, as is well known, is affiliated to the Allgemeine Elektricitäts-Gesellschaft of Berlin, the character and extent of whose work is very familiar to English electrical engineers, and the Electrical Company claims that no plant can be too large for it to take in hand. It has been further resolved that the company's electrolier department shall be removed to other premises, and the available space be converted into technical departments, drawing offices, &c., to facilitate the working out of the larger schemes which are anticipated, with the greatest rapidity. With an excellent staff of first-class engineers, the company is convinced that its business will increase on the same enormous scale as during the last two years. We have received from the company a large illustration of the interior of the immense works of the Allgemeine at Berlin, also a reference list of various dynamos and motors made by the company, a list of theatre installations carried out by them, and several other excellently illustrated catalogues in which the German company's manufactures are shown, among the photographs being views of some of the large lighting, power, and traction plants executed by them, including a list of three-phase transmission of power plants. The Electrical Company is already making considerable headway, for we understand that it has now over 4,000 H.P. running in the United Kingdom. The company has our wishes for success in its new development.

The Copper Market in June.—Messrs. H. R. Merton and Co.'s circular for the month ending June 30th, shows that during June the supplies of copper have been equal to 17,925 tons, while the deliveries have reached 19,077 tons. The corresponding figures for June, 1898, were 19,145 and 18,833 tons respectively. The decrease in supplies, as compared with June 12 months ago, extends to shipments from Spain, Portugal, Chili, Australia, and miscellaneous countries; only the American shipments to Europe show an increase. In view of the large number of mines which have been floated as companies during the last 12 months, and the influx of new capital into the copper mining industry, this non-expansion of supplies from countries other than America is disappointing, for, as pointed out in our previous reports, it is to these countries we must look for the increased supply which will prove fatal to the influence of the Amalgamated Copper Company. The excess of deliveries over supplies has resulted in a decrease of stocks by 1,152 tons during June, and the stock of copper on June 30th stood at 29,004 tons. The prices of G.M.B.'s have not fluctuated much during June, the values at the different dates being as follows:—

May 31st, £76 15s. June 15th, £75 10s. June 30th, £76 15s.

The relative prices of copper and aluminium, for conductors of equal length and equal sectional resistance are now represented by:—

$$\frac{8{\cdot}93 \times 8{\cdot}57 \times 59}{2{\cdot}68 \times 14{\cdot}5 \times 100} = \frac{4.508}{3,886} = \frac{116}{100}$$

There has been a decided lull in the flotation of new mining companies during June, and the prospectus of only one company has come under our notice. This is the Ray Copper Mines, Limited, capital £280,000, £50,000 of which is to be reserved as working capital. This company has been formed to acquire 52 mining claims, and a reduction plant at Mineral Creek, Arizona. The locality is 45 miles from the South Pacific Railway. 190,000 tons of ore, averaging 5½ per cent. of copper, are in sight, and developments of the properties are expected to increase this to 2,000,000 tons. The plant at Mineral Creek is equal to the treatment of 75 tons ore per day. The Globe Minerals Exploration Company are the vendors, and are re-selling for £210,000, payable £95,000 in cash, and £115,000 in shares. In view of the large number of new companies floated in London during the first half of this year, the following remarks, which appeared in the issue of the *Engineering and Mining Journal*, of New York, for April 15th, 1899, are of interest, and emphasise the need for caution on the part of investors. We have more than once drawn attention in these reports to this aspect of the recent activity in the copper mining market, but the *Engineering and Mining Journal*, of course, speaks with special information concerning American mines:—

Just at present the rapid increase in the price of copper and in the prevailing boom in copper shares, in the Boston and in the foreign markets have made copper stocks a favourite investment, and especially attractive to buyers of mining shares; and the copper vein is being worked accordingly. It is not possible to go at length into all the statements of the prospectuses and advertisements which crowd our desks. These all have a certain family resemblance; references to the prosperity and heavy dividends of the Calumet & Hecla, the United Verde, and a few other noted copper companies, constitute the bulk of the document, followed by a very little vague information—or misinformation—about the special company in question, and often by claims which, to the mining men, are so evidently ridiculous as to establish their falsity without further investigation. But these documents are not intended for the man who knows anything of mining; they are for that section of the public which is not informed, and the less that readers know, the better for the purposes of those who write and issue the documents. A favourite plan is to avoid all accurate description of the property itself, and to base its claims upon its neighbourhood to some well-known mine, which, it is assumed, will assure the value of the new property.

We have hardly space here to give a list of all the companies of doubtful value, which are now before the public; but it may be well to mention a few conspicuous instances, and to refer to a few prospectuses which need criticism, to say the least. Perhaps the most conspicuous offender in the list is the Spenszuma Gold Mining and Milling Company, of Arizona, which, we are informed, is disposing of stock through its agents among Connecticut farmers, in the towns along the Hudson River, and in other places, which are not likely to contain parties having information about mines.

Just at present, Arizona seems to be a favourite ground for these wild-cat companies, and especially for that class which are trading on the reputation of established mines. One conspicuous offender of this class is the Copper King, of Arizona, which has advertised extensively and has scattered prospectuses and circulars all over the country. The company is trading on its similiarity in name and the neighbourhood of its claims to the Copper Queen Mine, although the owners of that and other properties had long ago prospected the district thoroughly, and would certainly have taken up any claims of value had they existed there. This company not only trades on the similarity of names, but illustrates its circulars with views of the extensive buildings of the Copper Queen, thus attempting a deliberate fraud upon the readers.

We find other instances of trading on name and proximity, without going outside of Arizona, and although in these cases we have not been able as yet to make the necessary investigation to prove their worthlessness, they are at least destitute of all proven or developed values, and at the very best offer to the buyers of their stock gambles of the wildest kind. There is also the presumption that the neighbouring companies which are operating on a large scale would not leave valuable properties which they could have easily secured for themselves at the slight expense of locating and a little exploration and assessment work. In this class, we have the Arizona Copper Syndicate, which has claims at Clifton near the property of the well-known Arizona Copper Company; and a whole group—the United Verde, Jun., the United Verde Extension and the Val Verde—whose only distinction is that they are near W. A. Clark's well-known United Verde mines.

Mercantile Publishing Syndicate, Limited, v. The Western Union Telegraph Company, and the International Cable Directory Company.—On Monday, last week, in the Queen's Bench Division of the High Court of Justice, the cases of the Mercantile Publishing Syndicate, Limited, *v.* the Western Union Telegraph Company, and the same *v.* the International Cable Directory Company and another, came on for hearing before Mr. Justice Ridley. In these actions, Mr. Scrutton and Mr. Josephs appeared for the plaintiffs, who are the registered proprietors of a work entitled "The Broomhill's Comprehensive Cipher Code." Mr. English Harrison, Q.C., and Mr. A. J. Walter represented defendants in both cases. Mr. Scrutton, in opening the first case, said that in each of them the cause of action was the alleged infringement of a telegraph code, of which the plaintiffs held the copyright. Plaintiffs alleged that their copyright had been infringed by a code called the "Western Union Telegraph Code," ostensibly printed and published and imported into England by the International Cable Directory Company, whose agents in England, Messrs. Lilley & Tall, were the defendants in the second action. In each case the allegations in defence were that the book complained of was not an infringement of that of plaintiffs. In answer to his Lordship, Mr. English Harrison, Q.C., said he had reasons for objecting to the two cases being taken together, but the decision in one case would bind the other. Mr. Scrutton then put in the certificate of registration of the plaintiffs' code, which he said was *primâ facie* evidence of their copyright under statute, and the main question his Lordship would have to ascertain was whether the Western Union book was an infringement of plaintiffs. The learned Counsel quoted from decided cases, with a view to showing the application of law to the action in question, and then at some length Mr. Scrutton pointed out the similarity between the defendants' book and that of his clients, the plaintiffs. Their work, he said, was the result of 16 years experience, but the compiler of the defendants' code said he only took nine months in its preparation. At first he used plaintiffs' book sparingly, but it appeared that when he got near the end of his work he "lifted" from the plaintiffs' code in large batches, mistakes and all, and upon that counsel asked his Lordship for an injunction against the defendants. At the end of Mr. Scrutton's address, in the course of which he compared the works in dispute, Mr. English Harrison, Q.C., said that the code complained of was made in America under the superintendence of one gentleman, who had the aid of a number of others. It would appear from his learned friend's opening that one or other of those assistants had copied part of the plaintiffs' code. On behalf of the Western Union Telegraph Company, counsel intimated that he submitted to an injunction, and there were other terms which he need not mention, but which included the usual penalty. As regarded the other defendants, they had always denied that they had ever dealt with the books at all. They had, however, been presented with one book, and some other people had been handed copies and asked to sell them for their own profit, but not in connection with

the second defendant company. He (Mr. English Harrison) was afraid that there had been a technical infringement, and, therefore, he had to submit to an injunction. His Lordship made an order accordingly.

Electrical Wares Exported.

Week ending July 12th, 1898.

		Value
Adelaide		£142
Amsterdam		125
Antwerp		10
Bahia. Teleg. mat.		50
Bombay		8
Boulogne		90
Buenos Ayres. Teleg. mat.		450
Cape Town		165
Colombo		210
Copenhagen. Teleg. cable		550
Demerara. Teleg. mat.		99
Durban		20
East London		188
Fremantle. Teleg. mat.		84
Gothenburg		189
Hamburg		60
Hiogo		119
Hong Kong		30
Liban		50
Lisbon. Teleg. cable		200
Melbourne. Teleg. mat.		29
Ostend		80
Perth		600
Port Elizabeth		191
" Teleg. mat.		500
Santander		70
Shanghai. Teleg. mat.		300
Singapore. Teleg. mat.		22
Stockholm		12
" Teleg. mat.		215
Sydney		775
Total		£5,718

Week ending July 11th, 1899.

		Value
Alexandria. Teleph. mat.		£82
Amsterdam		181
Barcelona		14
Barranquilla. Teleg. mat.		111
Bilbao. Teleg. mat.		145
Bombay. Teleph. mat.		127
Boston (U.S.A.). Teleg. apps.		2,796
Boulogne		90
Buenos Ayres		70
" " Teleg. wire		560
Calcutta		382
Cape Town		176
Christiania		13
Copenhagen		17
Delagoa Bay		13
Demerara		15
" Teleg. mat.		123
Durban		388
" Elect. cable		1,432
" Teleg. mat.		1,357
East London		213
Fremantle		18
Gothenburg		23
Hamburg. Teleg. mat.		600
Helsingfors		39
Hobart. Teleg. cable		180
Kertch. Teleg. cable		3,000
Las Palmas		14
Madras		15
Mauritius		15
Melbourne		77
" Teleg. mat.		555
New York		12
Odessa		75
Ostend		20
Perth		13
Port Elizabeth		120
Rangoon		85
Rotterdam		108
" Teleg. mat.		117
Shanghai		2,188
Singapore		115
" Teleg. cable		18,000
St. Petersburg. Teleg. wire		110
Stockholm		36
Sydney		796
" Teleg. cable		570
Tientsin		65
Wellington		191
Yokohama. Elec. cable		138
Total		£35,490

Foreign Goods Transhipped.

Antwerp. Elec. mchny. Value £80

Electrical Wares Exported.

Week ending July 19th, 1898.

		Value
Alexandria. Teleg. mat.		£12,551
Amsterdam		155
Bahia Blanca. Teleg. mat.		288
Bangkok		13
Barcelona		400
Bilbao		20
Bombay		13
Bordeaux		22
Boulogne		141
Buenos Ayres		61
Calcutta		42
Cape Town		1,152
Copenhagen. Teleg. cable		49
Durban		195
" Teleph. mat.		40
Fremantle. Teleg. mat.		211
Gothenburg. Teleg. mat.		181
Halifax. Teleg. mat.		138
Hamburg. Teleg. mat.		36
Hong Kong		21
Lisbon. Teleg. mat.		96
Mackay		4,200
Malta		10
Marseilles		81
North Atlantic. Teleg. cable.		11,400
Port Elizabeth		181
Rio Janeiro		19
Santander		450
St. Petersburg		61
" Teleg. cable		156
Singapore. Telephone		22
Stockholm. Teleg. cable		2,014
Sydney		1,378
Trinidad		33
Wellington		139
Total		£35,973

Week ending July 18th, 1899.

		Value
Amsterdam		£20
Boulogne		1,000
Brussels		90
Buenos Ayres		1,426
" " Elec cable		900
" " Teleg. wire		264
Calcutta		283
Cape Town		690
Christiania		61
Colombo		213
Copenhagen		80
Durban		277
East London		517
" " Teleg. mat.		1,076
Gothenburg		40
Hamburg		110
Hong Kong		595
King George's Sound		67
Leghorn		52
Lyttleton		60
Malta		195
Marseilles		36
Mauritius		27
Ostend		20
Port Elizabeth		355
Rio Janeiro. 105 tons teleg. wire (value not declared)		—
Shanghai. 26 tons old teleg. wire (value not declared)		—
Singapore		40
" Teleg. stores		40
St. Petersburg. Teleg. cable mat.		235
Stockholm		9
Sydney		28
" Teleg. cable		668
Total		£9,454

Foreign Goods Transhipped.

Odessa Value £17

Cowper-Coles Magnetic Scale Collector.—The removal of mill scale from forgings and plates has always been a matter of considerable difficulty, the scale in many cases being $\frac{1}{32}$-inch in thickness. The usual practice is to place the iron in a solution containing one part of hydrochloric or sulphuric acid, to 10 parts of water for from half an hour to 24 hours. The Admiralty specify that all steel steam pipes, boiler and collector tubes, and all plates for boilers, are to be pickled in a solution consisting of 19 parts of water and 1 of hydrochloric acid until the black oxide and scale formed during the process of manufacture is completely removed. The amount of acid consumed in the pickling of close annealed sheets, such as are used for roofing purposes, varies from 3 cwt. to 7 cwt. of muriatic acid per ton of sheets; if sulphuric acid is used, considerably less is required. Muriatic acid is used in preference to sulphuric by a large number of manufacturers, because it is cheaper bulk for bulk, and also because it acts less quickly on the skin of the metal, and consequently has less tendency to eat it away. In Worcestershire alone about 1,000 carboys of acid corresponding to some 27,000 gallons of waste pickle have to be

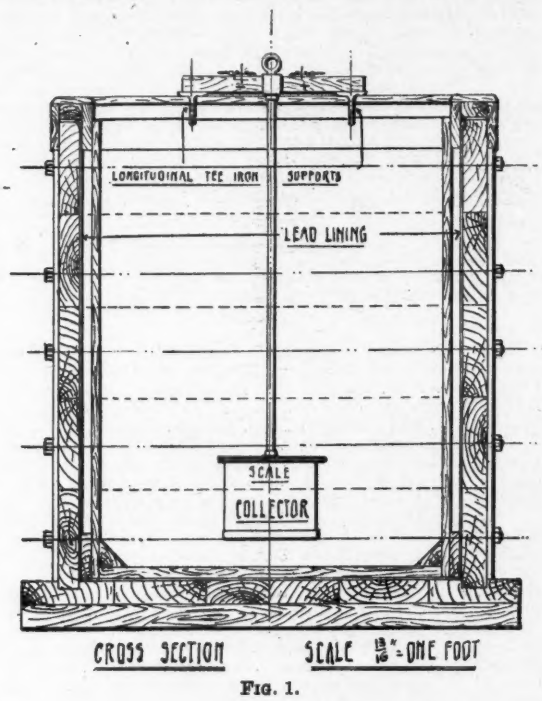


Fig. 1.

got rid of weekly. During the process of pickling large quantities of magnetic oxide and scale become detached from the plates, which if allowed to remain in the pickle to be further acted on by the acid, form a serious source of loss. The present invention has

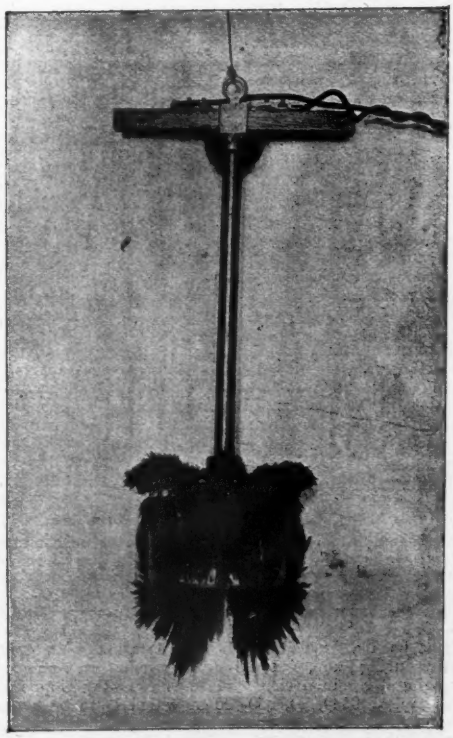


Fig. 2.

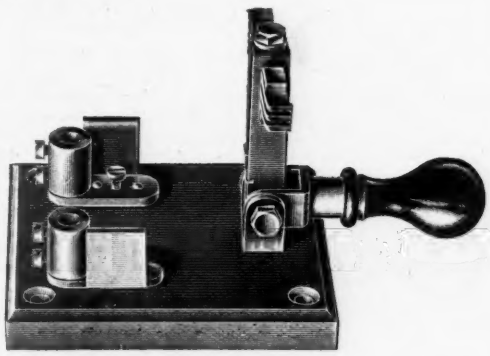
for its object the prevention or diminution of this loss, which is accomplished by means of the apparatus shown in fig. 1, which gives a sectional elevation of a lead-lined pickling tank, with a

scale collector placed in position. The scale collector is placed in any convenient position in the tank, and connected by means of terminals A A to a depositing or electric lighting dynamo, the current required to work it being about 10 amperes when an E.M.F. of 6 volts is employed. In the case of large baths two or more collectors can be employed, or only one may be used, this being moved about to different parts of the bath at suitable intervals. From time to time the scale collector is taken out, and the adhering scale removed, either by breaking the circuit, or by means of a suitable brush or scraper. Fig. 2 is taken from a photograph of the apparatus after it has been dipped in iron filings; it will be noticed that the electro-magnet has consequent poles, this method of connecting up having been adopted with the object of distributing the field as much as possible. The following are the advantages claimed for the adoption of the Cowper-Coles patent scale collector:—(1) A great saving of acid is effected. (2) The apparatus is attached without any difficulty to any ordinary lead-lined pickling vat, and does not require skilled labour to look after it. (3) All the magnetic oxide or scale on the plate is collected almost as soon as it leaves the iron or steel, instead of being allowed to remain in the solution and be acted on by the acid as at present. (4) In large works, where a considerable quantity of acid is used per week, a great economy will be effected, as considerably less acid is required, and consequently there is less spent pickle to be got rid of.

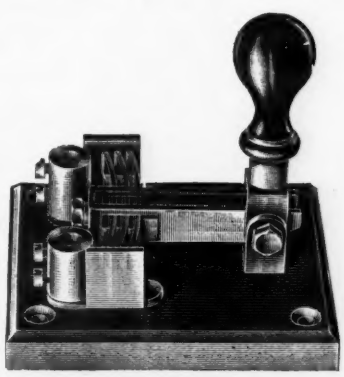
Rossell's Smoke Preventer.—Bituminous coal cannot be burned smokelessly except in furnaces arranged so that the products of combustion sweep over the surface of the fire, and become thoroughly mingled with a proportion of fresh air, admitted preferably at the door. When thus mixed it is essential that the gases be at a sufficient temperature to ignite, that they have space in which to burn freely, and be not unduly cooled down. The devices for admitting air are numerous, and a new one is being introduced by Messrs. Rossell & Co., of Sheffield. It is based on the admission of air for a short period after each fresh charge of fuel. This air is required by the hydro-carbon gases which are distilled off each fresh charge, and it is necessary that air admission should cease gradually as the gas supply becomes exhausted. The apparatus consists of a number of louvres in the door of the furnace. Each louvre carries a central bulb, and these bulbs rest one upon another in such a way that pressure on the lowest will raise all and open the louvres. In opening the furnace door the requisite upward pressure is supplied by means of a bell crank and a bracket, which presses on the bell crank lever and opens the louvres and raises an oil cataract or dash-pot piston. Closing the furnace door sets free the louvres to fall, but they only do so slowly under the cataract action, which is controllable by means of a cock in the bye-pass. We used a similar device many years ago; the same effect may also be obtained by means of a clock-work arrangement, actuated by a chain and by the weight of the louvres themselves. There is no necessity to reproduce the tests which accompany the description of this device in the *Engineer*. The principle is a good one, which if carefully worked will produce smokeless combustion, and will sometimes do so at an actual economy of fuel. While air is being admitted above the fire, less air enters below and the fire is checked. Smoke prevention is thus apt to cause less steam to be made, and this is its chief disadvantage, only to be remedied by forced or assisted draught; this requires specially adapted devices to admit air which must be in parallel with the undergrate draught.

Feed Water Heater.—A novel feed heater has been introduced by Messrs. McPhail & Simpson, in which the feed to the boiler is allowed to fall in a divided shower through the steam space of a vertical egg-ended vessel, and then over a series of trays which serve to separate out lime salts. The idea on which this auxiliary feed heater is based is that of securing that the boiler feed, no matter how it may first be heated by an economiser or by other means, shall be exposed to steam at full boiler pressure, in order that it may finally pass into the boiler at full temperature. A boiler thus fed has simply to supply the latent heat of evaporation. The idea is sound enough, though here we would speak a word of caution against the neglect of ordinary economical methods of feed heating, as by the use of a coil, or the flue heater, or economiser. These methods are not to be considered antiquated. It might be supposed they were, from the neglect with which they have been so often treated. There are still far too many places where the feed is run dead cold into the boiler without even the apology of running an exhaust coil through the water tank, or using such an appliance as the Berryman heater. Once we were employed in an electrical station where there was an economiser. The feed went cold into the boilers and the economiser was shut off. One of the young electrical engineers in charge said that the economiser was useless, and did not pay for using; Mr. X. had therefore ordered it to be disconnected, the said Mr. X. being the consulting engineer, who ought to have known better. This new apparatus of McPhail & Simpson's has its place, but not in every station. It seems to us to have been made to sell in deference to the new fashion of live steam feed heating, which has been carried to an absurd excess by men of the class who are throwing away sufficient exhaust steam to boil all their feed. Very much of the recent steam practice of this country has been carried out in a most careless and uneconomical manner, and upon most degenerate lines, while at the same time the complications introduced have been serious and uncalled for, and have not resulted in corresponding economies. What with non-condensing engines, and cold feeds and wasteful auxiliaries, we much fear that the adoption of so much American practice has not been an unmixed blessing.

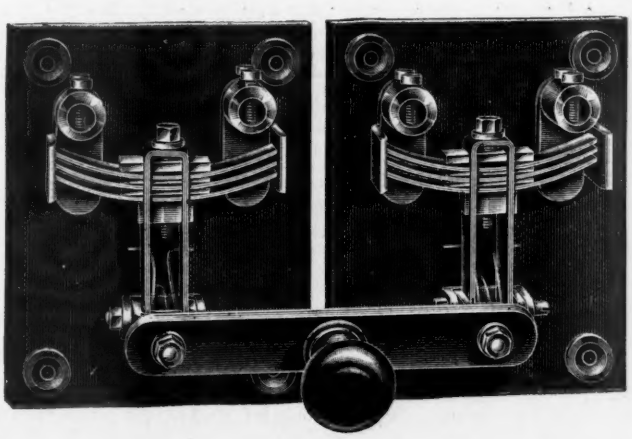
High Pressure Switch.—We illustrate below a new high pressure main switch, which is being sold by Messrs. Hill, Gifkins & Co., of Victoria Street, S.W. It is claimed to have an extremely long and wide break, and has been passed by a large number of high pressure supply companies. It is also being used



extensively for tramway and other similar undertakings. Among the other improvements are the easy replacement of the bridge pieces, and the adjustment of the same by the screw at the top. There are only three sizes up to, say, 100 amperes, the intermediate



sizes being obtained by the addition of extra laminations at the cost of a few pence each, each lamination being arranged for 5 amperes according to size of switch. There is a slot in the U piece which permits of the mechanical centering of the bridge

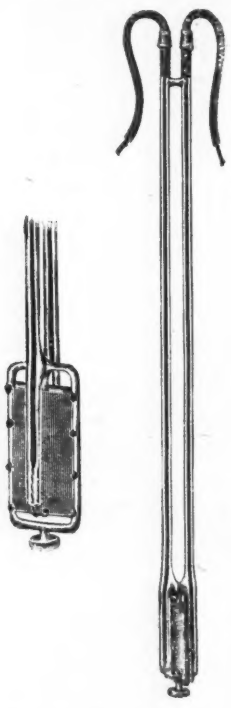


pieces between the contacts. The switch is made up entirely of stampings so that it is economical in price. There are hollow terminals and double binding screws which are found in practice to efficiently clip the cable without sweating thimbles into the sockets.

Lyall's Water-Tube Boiler.—This is a combination boiler. With the shell of a tubular boiler is the combustion chamber of a marine boiler with flat stayed surfaces, and below is a furnace, the roof of which is made of water tubes expanded into back and front headers and specially arranged, as it seems to us, to prevent good combustion. A large combustion chamber is placed between

the water-tubes and the fire-tubes. We do not doubt the claim made for good circulation, but we do not see any special virtue in this boiler. It has too much complication; and we do not agree that the water-tubes are so few that they will not chill off the gases too quickly. We think they very probably will do just this. It preserves too many of the structural faults of old boilers, while introducing some of the worst features of the new types of boiler. The boiler would be improved by removing the water-tubes altogether, and using simply a firebrick furnace, but it would then be an underfired cylindrical boiler, and those blessed words, "water-tube," would be absent.

Bastian Meter—New Type.—A few days ago we examined the new type of meter which has been adopted by the Bastian Meter Company, and of which we give a detail view showing the improvements. The conductors are not sealed into the bulb at the bottom of the vessel containing the electrolyte, as used to be the case, but are brought down inside the vessel in glass tubes; the latter are fastened together by glass cross-pieces to form a stiff frame, which is supported by a rubber stopper. The conductors consist of stout leaden wires, which are sealed into the upper part of the tubes with pitch, and are joined to the platinum



foil electrodes with short lengths of platinum wire, as seen in the enlarged detail. The lead-platinum joints are always surrounded by air, so that there is no danger of their being corroded. The meter which we saw is, we are informed, the first 2½ ampere meter to be put upon the market in this country, and is quoted at two guineas net. It will be remembered that at the meeting of the Municipal Electrical Association at Bristol the excessive cost of electricity meters, as compared with gas meters, was discussed. Mr. Bastian's meter, however, goes far to bridge the gulf, and with free wiring should help to popularise electric lighting.

Automobiles at the 1900 Paris Exhibition.—The committee of the Royal Commission for the Paris Exhibition of 1900 have nominated the Automobile Club as the consulting body to act in co-operation with the Royal Commission in reference to the automobile section of the Paris Exhibition of 1900. The exhibition is to open on April 15th, and to close on November 5th. Applications for space should be made direct to the secretary of the Royal Commission, St. Stephen's House, Westminster, S.W. Forms of application may be obtained from either the secretary of the Royal Commission, or from the secretary of the Automobile Club, 4, Whitehall Court, S.W. There will be no charge for space. In order to secure that adequate space shall be reserved for the display of the automobiles of British firms, it is requested that those firms who are not at present in a position to apply to the Royal Commission for space, should inform the secretary of the Automobile Club about what superficial area they are likely to require for their exhibits.

Two-Rate Meter.—An ingenious device, intended to supersede the usual combination of demand indicator and supply meter, is being introduced by Messrs. Chamberlain & Hookham. The apparatus consists of their ordinary meter modified by the addition of a second counting train and dial; either train may be driven by the mechanism, but not both at once. The action of the apparatus is as follows:—When a small current is flowing, the lower counting train is in gear; but when the current exceeds a certain predetermined value, the upper train is thrown into gear by means of an electro-magnet in series with the main current, and the record is made on the upper dial. A pointer indicates the dial upon which the record is being made at any time. It is pointed out that the apparatus not only effects the same object as the demand indicator, but greatly reduces the burden of book-keeping, which is very heavy on the present system; further, the first cost is less, as the meter costs but little more than the ordinary form. While the result is not precisely the same as that of the demand indicator system, the disadvantage of the latter—viz., that an accidental heavy current for a short time taxes the consumer on the whole of his meter record—is eliminated, with a consequent diminution of complaints and discontent on the part of the consumer.

Outings.—The annual outing of Messrs. Marryatt and Place, of Hatton Garden and Shepherd's Bush, took place on Saturday, the 15th, when the employés and friends, numbering between 40 and 50, journeyed by G.W.R. to Staines, where the steam launch *Windsor Castle* awaited them to convey them to Windsor. Arrived there, lunch was served in first-class style at the White Hart Hotel, and afterwards the party proceeded to Cookham and then returned to Maidenhead, where dinner was served at the White Horse Hotel. After the usual toasts the health of "The Firm" was proposed and enthusiastically drunk, Mr. Marryatt responding. The toast of "The visitors" was also responded to in a neat speech. Then came the toast of "Sweethearts and Wives," which was drunk with great acclamation and responded to in a very witty and humorous speech by a visitor. This was most appropriate, as Mr. Marryatt (the head of the firm), is very shortly to be married, and he made this the occasion of his wedding dinner to the employés, kindly defraying all expenses. After dinner a concert was held, and various members of the firm added greatly to the enjoyment of the company, Mr. Place and Mr. Ralph, works manager, giving some exceptionally good songs. After a most enjoyable day the party returned to London, arriving about 11.30 p.m.

W. T. Burbey & Co.—The employés of this firm held their annual beanfeast on Saturday last. Special carriages conveyed the party by rail to Tonbridge, where a most enjoyable day was spent, chiefly in boating on the river Medway. Dinner was well provided for at the Castle Hotel. The toast of "Health and Success to the Firm" was proposed by Mr. Jones, to which Mr. Burbey responded. Other toasts followed, and the speeches throughout fully indicated the unity and interest existing between the masters and men.

Provisional Orders.—The Bill confirming a provisional order granted by the Board of Trade to the Urban Electric Supply Company, in respect of the Urban District of Newton Abbot, the other day proved compliance with the Standing Orders, and was sent by the examiner for second reading in the House of Lords. The Bill has passed through the Lower House.

Official notice has been given of the withdrawal of the opposition which was threatened in the House of Lords to the passing of the Bill promoted by the Brompton and Piccadilly Circus Railway Company, which has already passed the House of Commons.

The Bill to confirm the Walker Urban District Council's electric lighting provisional order received the Royal assent on Friday, the 14th inst.

The Trolley Car and Municipal Street Sanitary Departments.—Though we believe that the greatest service which electricity can render to city life will be that due to the increased facilities for cheap and rapid transport from the city to the suburbs, the general adoption of electric traction in place of horse traction is likely to be followed by other surprising changes. We learn on good authority that in Boston the trolley system is being used for the distribution of merchandise, coal, &c., by night; that in Sheffield they possess, or are about to possess, a trolley car equipped with brushes for street sweeping; and that in Baltimore the street sprinkling is effected by means of an electric road sprinkler. It only remains for some genius to invent an electric dust cart, for the whole service of the street scavenging departments of our larger cities to be performed automatically by the street trolley car.

Bankruptcy Proceedings, &c.—The public examination of Edward L. Joseph, electrical engineer, of the Northampton Works, Northampton Grove, Canonbury, was held at the London Bankruptcy Court on the 13th inst. before Mr. Registrar Hope. The debtor applied to pass upon accounts showing liabilities £7,618 9s. 1d., and assets consisting of 4,293 shares in Williamson and Joseph, Limited, and a book debt of £5,634 16s. that he claims from the same company. Questioned by Mr. G. W. Chapman, official receiver, the debtor stated that having acted as manager to Messrs. Appleton, Burbey & Williamson, he was, in August, 1891, admitted as a partner. He introduced no capital, but his father advanced to the firm £1,600, which loan was repaid two or three years afterwards. As a partner he was entitled to a percentage of the turnover, which came out at about £5[illegible]0 a year, but he only drew out £3[illegible]0 per annum because the profits were not sufficient to permit the arrangement to be carried through. Mr. Appleton retired from the firm in 1893, and Mr. Burbey followed suit in the following year. Witness and Mr. Williamson continued the business until 1896, when the latter retired, and Williamson and Joseph, Limited, was formed to take over the concern. A balance sheet then made out showed that the trading for the previous year had resulted in a considerable loss, but there remained a capital of £9,052. Witness undertook to pay half that sum to Mr. Williamson for his share in the concern, and that now formed the greater part of his (debtor's) present liabilities. The nominal capital of Williamson & Joseph, Limited, was £10,000 in shares, and £5,500 in debentures of £500 each. As vendor witness was to receive £4,526 in cash by quarterly instalments of £100

each, and 4,993 fully paid shares. The shares were duly allotted, but he only received three of the £100 instalments. He handed over that £300 to Mr. Williamson, who devoted it to the discharge of liabilities of the old firm. The property transferred to the company was the same as that which appeared in the balance sheet at the value of £9,052, nothing being put down for the goodwill. The company removed the business from Sard's Rents, Bermondsey, to Canonbury in September, 1898, where in April last a receiver was appointed on behalf of the debenture holders. Witness had acted as manager for the company at a salary of £8 a week, but had only drawn at the rate of £300 a year and he was still employed in the same capacity by the Receiver. He obtained an option for the lease of Northampton Works on behalf of the company, and that option had been charged to secure a debt of £600 owing by the company but guaranteed by himself. He entirely attributed his appearance at the Court to the failure of the company and its consequent inability to discharge liabilities that he had guaranteed. It was a fact that he possessed no assets outside the company, and that his only prospect of paying the guarantees was its success. In reply to a solicitor appearing for the trustee and creditors, the debtor said a resolution was passed on May 29th last for the company to be wound up voluntarily. Although he personally held a large proportion of the shares, he did not vote upon the resolution, which was moved by independent shareholders. A petition for a compulsory winding up order had been previously lodged in the High Court, but it was not in consequence of the presentation of that petition that the resolution for voluntary liquidation was passed. Witness had opposed the claims of Mr. Edwards and Mr. Hall. In the case of the first named creditor a judgment was obtained in the absence of witness, although notice was given him that the action would not be proceeded with on that day. There had been a loss on the company's trading, but he could not possibly state the amount. (Q.) Why was the resolution to wind up the company decided upon? (A.) Simply because the company could not pay its debts. (Q.) Now, sir, was there *any* reason for winding up the company? (A) Certainly; otherwise I presume it would not have been done. (Q.) I suggest that *you* wound up the company in order to get rid of your own debts? (A.) Certainly not. The company had been sued by some of its trade creditors. In reply to further questions the witness stated that the company received £3,000 as compensation from the London County Council. That money was devoted to paying off loans. Mr. Leggatt Rubenstein attended for the debtor, who was allowed to pass.

At the Liverpool Bankruptcy Court, on July 13th, before Mr. Registrar Cooper, the public examination was taken of Benjamin Wild and John Henry Clarke, who carried on business in partnership at the Atlas Works, Virginia Street, Southport, under the style of "Wild, Rothwell & Co.," as general and electrical engineers. Mr. Nathan Yates, chartered accountant, Bolton, who has been appointed trustee, was present, and Mr. T. H. Williams, solicitor, Southport, represented the debtors. The statement of affairs shows liabilities £2,509, and assets estimated at £770 net. The examination was adjourned to August 10th.

A statement has been issued by the Official Receiver (Mr. J. Arthur Binns) to the creditors of Arthur Blackburn, of Marriott Street, Dewsbury, and James Walker, of 88, Dale Street, Batley Carr, carrying on business in partnership as electrical and mechanical engineers at Upper Lane Mills, Cleckheaton, under the style of Blackburn, Walker & Co. The liabilities are expected to rank at £217, and the assets are estimated to produce £79. The debtors, who commenced business in 1893, attribute their insolvency to losses on contracts and to want of capital.

Liquidation.—Williamson & Joseph, Limited.—A meeting of creditors of this company was held on Tuesday the 18th inst., at the Guildhall Tavern, Gresham Street, London. It was convened by Mr. Stephen P. Child, the liquidator of the company, who presented a statement of affairs, and who suggested that the meeting if it saw fit, should appoint a committee of creditors to co-operate with him in liquidating the affairs of the company. After some opposition from a solicitor, said to represent the petitioning creditor, and who desired to see appointed a co-liquidator with Mr. Child, a committee was nominated consisting of Messrs. Woodall (Mackintyre & Co., Limited, Burslem); F. Espir, Pinchbeck (Marriott's, Limited), the legal representative of Messrs. Wheatley Kirk, Price & Goulty, and the legal representative of Mr. E. L. Joseph. The proceedings then terminated.

Aron Meter.—The Board of Trade in the *London Gazette* of July 14th announces its approval of the Aron (alternating current) meter for use on two and three-phase systems, and specifies the mode of fixing and connecting the meter.

Catalogues, Lists, &c.—Messrs. Schattner & Co., of Timberhill, Norwich, send us an illustrated pamphlet describing the Long-Schattner prepayment meter, already well known to our readers.

An interesting catalogue comes to hand from the Wheeler Condenser and Engineering Company, of Queen Victoria Street. Some general observations on auxiliary devices for increasing steam engine economy are followed by notes and sketches describing Wheeler's double and single tube surface condensers, light weight jet and surface condensers, the Volz patent combined surface condenser and feed water heater, the Barnard water-cooling tower, Wheeler's feed water heater and combined reheater and receiver. The illustrations are excellent.

From Messrs. W. F. Dennis & Co., of Billiter Street, E.C., we have received a catalogue dealing with he products and manufactures of Messrs. Felten & Guilleau of Mülheim-on-Rhine. Some good pictures are given of the firm's various manufactures, including telegraph, telephone, and electric light cables, wire goods, chains, &c.

The Knecht Bros. Company, of Cincinnati, Ohio, send us a leaflet of their patent friction sensitive drill.

We have received a list of electrically-driven and other fans from Messrs. John Gibbs & Son, Liverpool; the special feature of these fans is the method of securing the blades by means of a double boss locking with flanges on the blades, so that the latter cannot possibly be thrown out. A neat motor-starting switch is also shown, which is designed to render accidental damage to the motor an impossibility.

Messrs. Paterson & Cooper's most recent catalogue, which we have received, shows voltmeters and ammeters at prices ranging from £2 upwards, of various types—gravity, permanent magnet, spring control, &c.—and Cardew voltmeters, and includes a useful reference table and price list of cables and wires.

The Maire Paint Company has sent us particulars of the Maire indestructible roof preserver, which, it is stated, is *not* a paint, and contains no oil.

Messrs. J. Beardshaw & Son, Limited, of Cannon Street, E.C., and Sheffield, have issued a new list of Sheffield steel and other goods, including engineers' and contractors' tools, agricultural implements, circular saws, profile tool steel. A handy telegraph code is given.

Messrs. Marryat & Place, of Hatton Garden, send us an illustrated price list of their "M.P." switches, switchboards, &c., for electric light and power.

We have received lists from Messrs. Johnson & Phillips, who have acquired the English patent rights of the Hartmann & Braun hot wire instruments for direct and alternating current, and are manufacturing them at their Charlton works. As is well known, in these instruments a short wire of platinum-silver alloy carries the current, and the elongation of this wire is transmitted to a pointer pivoted in jewels through a simple magnifying device. A zero adjustment is provided, and magnetic damping. The new patent "J. & P." supply meter is also illustrated; this is constructed on the integrating principle, combining a time-keeping mechanism with an amperemeter or wattmeter, as the case may be, and recording the product of these factors on the dials.

New Resistance Material.—During the past few days Messrs. Veritys have had at their showrooms in King Street, Covent Garden, some samples of the new resistance material which is being exploited by the Electric Resistance and Heating Company, Limited, whose prospectus is now before the public. As far as one could see the material is calculated to simplify the construction and regulation of a great number of electric appliances used for traction, lighting, cooking, and other purposes. Resistances made of this material cost less than present forms and occupy considerably less space. The composition is quite plastic, tough, and durable, so that it is very suitable for cooking utensils; and for heating rooms it is capable of being treated with a view to ornament.

New Resistance Switches.—We have received from Messrs. Mayes & Spikins, Hove, an account of their patent Phœnix motor controllers and arc lamp resistances. No wire is used in these, the substitute being powdered graphite, and every switch is practically indestructible, being capable of carrying four times its normal current without injury. The motor controller may be had with automatic maximum and minimum cut-outs, and is arranged either for regulating or for starting only; the price is extremely moderate—a most important feature, for our English motor starters, as a rule, have a tendency to be terribly dear.

Shipowners' Technical Code Book.—We have received from Messrs. Charles Barker & Sons, of Birchin Lane, a copy of this book which has been compiled by Mr. Walter Phillips to meet the requirements of shipowners and their captains. It is of course mainly nautical, but includes a Glossary of Terms used in electricity with code words and numbers. This list will probably be found useful in shipping circles, though it is marred by a number of misprints and includes a few items that are obsolete.

Trade Announcements.—We are informed that Mr. G. H. Gibson, formerly a member of Binko & Co., of Leadenhall Street, and subsequently a director of Messrs. Binko, Ridsdale & Co., Limited, has joined the firm of Messrs. Nunn, Ridsdale & Co., of Shadwell, wholesale ship chandlers and nautical and other lamp manufacturers, that firm having acquired the business of Messrs. Ridsdale & Co., of the Minories. He has no connection with any other firm or business.

The General Electric Company, Limited, announces that it is now in a position to supply the dry cells used for the De Dion motor cycle, both singly and in sets with rubber cases.

We are informed that Messrs. Gent & Co. have removed their London office from Maiden Lane to 25, Laurence Pountney Lane, E.C., where an increased stock will be carried, under the management of Mr. H. M. Harris.

ELECTRIC LIGHTING NOTES.

Alva.—At the monthly meeting of the Burgh Commissioners, held on 10th inst., it was stated that the Electric Light Committee had decided that the time had not yet arrived when they should take up the question of lighting the burgh with electricity.

Ambleside.—The District Council has entered into an agreement with the Windermere and District Electricity Supply Company for the supply of electrical energy at 3d. per unit, while the Council will lay the mains and re-sell at 7d. per unit.

Barrow.—The Corporation electricity works is to be officially started on the 27th inst.

Bermondsey.—At a meeting on Monday, the Electric Lighting Committee recommended the Vestry to engage Messrs. Kincaid, Waller & Manville to advise the Vestry in the matter of the electricity works and refuse destructor, at a fee of 5 per cent. on the amount of the contracts. A long and unseemly discussion followed, but eventually the recommendation was unanimously adopted.

Berwick.—At a meeting of the Sanitary Authority on July 11th, the clerk intimated that he had received two letters, one from Edmundsons' Electricity Corporation, Limited, and the other from the Electric Power Distribution Company, giving notice that they intended to apply for provisional orders during the Parliamentary session of 1900 to introduce the electric light into Berwick. The question of lighting the town with electric light was referred to the Lighting and Works Committees, which were also empowered to get the advice of an electrical engineer on the subject.

Brechin.—A letter was read at the Police Commission meeting on July 11th from Edmundson's Electricity Corporation, Limited, asking the Commission to transfer the provisional order for electric lighting in the burgh to the Angus Electric Light Company, in terms of the agreement between the Commission and Edmundson's, Limited. The letter was remitted to the Electric Light Committee.

Bristol.—The Local Government Board has given its sanction to a loan of £41,650 in connection with the extension now about to be undertaken.

Broughty Ferry.—A committee of the Broughty Ferry Burgh Commissioners, on July 10th, considered a letter from Edmundson's Electricity Corporation, Limited, on behalf of the Urban Electric Supply Company, Limited, notifying the company's intention to apply for a provisional order for the burgh, and offering special facilities to purchase. The committee resolved to oppose the application, and to apply on its own account, and inquiries were set on foot as to a suitable engineer, who might draw up a report on the subject.

Camberwell.—The Vestry considered the report of Major Cardew, R.E., on the question of purchasing the electric lighting undertaking of the County of London and Brush Provincial Electric Lighting Company, at a meeting on July 12th. The report stated that the Vestry would have to pay 133 per cent. on the amount of the capital account, as well as a sum equal to 5 per cent. dividend for one year; in addition, the Vestry would have to erect a generating station, make house connections, &c. The total capital expenditure was estimated at £140,000. It was resolved that the supply of electricity should be in the hands of the local authority, that the Electric Lighting Company should be informed of the above resolution and be asked whether they would assist the Vestry by giving particulars of the work already done, and that the offer of the English Industrials, Limited, to lease or take over the cables, be not entertained at present.

Cardiff.—The Town Council has approved the recommendation of the Lighting Committee that one of the fitters in the electricity works be given a month's trial as electrician.

Charlton Kings.—The Cheltenham Corporation has informed the District Council of its intention to apply this year for a provisional order for supplying the district or parts of the district with electric light. The consent of the Council was given to the proposed extension, subject to such conditions as the Council might hereafter prescribe.

Chislehurst.—The Chislehurst Parish Council has abandoned the proposal to light the streets with electricity.

Coatbridge.—At a meeting of the Town Council on July 12th, Councillor Lavell moved that a committee be appointed to negotiate with the Scottish House-to House Electricity Company as to the terms on which they would be prepared to sell their Coatbridge undertaking, with a view to its being acquired by the Council in the interest of the community. The matter was remitted to the Fire and Lighting Committee to make inquiries.

Colne.—It was decided to give effect to the Colne Electric Light Order, 1897, with the view of supplying electricity within the borough.

Continental Notes.—GERMANY.—A large central station is about to be established at Thörl; water-power is to be utilised, about 4,000 HP, it is said, being available. The establishment of a central electric lighting station in the town of Bommern has just been decided upon.

FRANCE.—A company has just been formed in Paris with a capital of £8,000 to be known as La Compagnie Francaise d'Exploitation des Lampes Electriques à Arc (Système Hegner). The question of electrically lighting the harbour of Cherbourg is under consideration.

AUSTRIA.—At the end of May last the central stations of the Oesttereichische Gesellschaft of Vienna were supplying electric power equivalent to 120,442 hectowatts, as compared with 114,600 hectowatts a year ago.

RUSSIA.—The "Volta" is the name of a new company which has just been formed at Reval, with a capital of 1,500,000 roubles, to carry on an electrical engineering business.

Derry.—A special meeting of the Corporation was held on 10th inst. to consider a report from Mr. Christie, electrical engineer to the Glasgow Corporation, on the offer of the British Thomson-Houston Company, London, to take over the public and private lighting of the city and establish a system of electric trams, which the company would work. The report stated that the Corporation would be quite capable of working a system of public and private electric lighting, and should not hand its interests over to any company. It was resolved that the report be printed for the benefit of the Council.

Devonport.—The Corporation has received an offer from the Devonport and District (Electric) Tramways Company to take over the Corporation's electric lighting order. The offer, the terms of which have not been stated, was not entertained.

Dorchester.—At a meeting of the Town Council last week a letter was read from Edmundson's Electricity Corporation, Limited (writing on behalf of the Urban Electric Supply Company, Limited), notifying their intention to apply to the Board of Trade for a provisional order for supplying the borough with electric light. If the Council assented to the application being made, the company undertook to insert special clauses in the order giving the Council option to purchase the undertaking at a much earlier period than was provided for in the Electric Lighting Act. The letter was referred to the General Purposes Committee.

Dundee.—A deputation from the Town Council visited Blackpool last week for the purpose of inspecting the electric light and tramway installation.

East Barnet Valley.—At a meeting of the District Council on 4th inst. a letter was read from the North Metropolitan Electrical Power Distribution Company, Limited, stating that application was intended to be made by them on or before December 21st next for a provisional order to supply electrical energy for public or private purposes within the urban district of East Barnet Valley. It was decided to write to the Board of Trade, intimating that the Council objected to the proposed scheme.

Edmonton.—The District Council has received notice from the North Metropolitan Electric Power Company of its intention to apply for a provisional order, and has decided to apply for an order itself.

Epsom.—The District Council, on the advice of its engineer, Mr. Hawtayne, has decided to apply for power to borrow £16,100 in order to carry out its provisional order.

Gosport.—The Electrical Power Distribution Company has intimated to the District Council that it has made an application to the Board of Trade for a provisional order authorising it to light the district of Gosport and Alverstoke by means of electricity.

Govan.—At a meeting of the Commissioners on July 10th it was decided to apply to the Secretary for Scotland for power to borrow £50,000 for electrical purposes under the Govan Burgh Provisional Order.

Hammersmith.—At a meeting of the Vestry on July 19th it was stated that the London County Council was prepared to advance to the Vestry £30,000, part of a loan of £69,000, to meet the cost of extending the electric lighting installation, such sum to be repaid by instalments extending over 42 years, and to bear interest at the rate of 3 per cent. per annum. The Vestry resolved to accept the loan on the said terms, and to form a sinking fund for the purpose of any renewals of machinery, &c., which might be needed during the currency of the loan. At the same meeting the Vestry decided to oppose the application of the District Electrical Supply Company, Limited, for a provisional order to supply electricity in the parish.

Hereford.—The County Council is considering the question of installing the electric light in the Hereford County and City Asylum, at an estimated cost of about £6,000.

Hove.—The Hove Electric Lighting Company, Limited, announces that an important reduction in the prices charged to consumers of the electric light will be made on January 1st, 1900.

Hoylake.—The District Council has adopted an electric lighting scheme drawn up by Mr. T. L. Miller, on the alternating current system, at an estimated cost of £26,000.

Hythe.—A letter was received by the District Council last week from Mr. F. Hall, of Folkestone, notifying that he intended, on behalf of the Folkestone Electricity Supply Company, to make application for a provisional order to supply the town of Hythe with electricity. The Council decided to ascertain the best terms of Mr. Hall for the supply of electricity, and to approach the South-Eastern Railway Company to find out whether it was prepared to move in the matter.

Yeadon.—At a meeting of the District Council on July 17th, Mr. Reuben Yeadon presiding, a letter was read giving formal notice on behalf of Messrs. Greenwood & Batley, Leeds, of their intention to apply, on behalf of a company they propose to form, for an electric lighting order for the area of the urban district of Yeadon and probably some other adjoining areas. It was resolved that the provisional order obtained by the Council in 1894 should be put into operation, and that an expert be engaged to advise them as to the best method to adopt.

Inverness.—The Town Council on July 11th decided to adopt steam-power for the electricity works, instead of water-power, in accordance with a report drawn up by Mr. Craven on the subject. The matter is to be actively pushed forward at once.

Lanark.—The Town Council has instructed the Street Committee to consider and report on the matter of having the streets lit by electricity.

Leek.—The District Council has received notice from the Electrical Power Distribution Company of its intention to apply to Parliament next session for power to supply electricity within the urban district of Leek. It was decided to inform the company that the Council would oppose the application.

Leicester.—The electric lighting of the extensive chemical factory of Messrs. J. Richardson & Co., Limited, of Leicester, has been placed in the hands of Messrs. Ellis & Ward, of Birmingham.

Llanrwst.—The District Council has had before it the question of public electric lighting. Tenders were submitted for street lighting during the ensuing year from the local electricity supply company and from the Holyhead and North Wales Gas and Water Company. Subject to a contract for three or five years, the electric company offered, under stated conditions, to supply the light for 25s. per lamp per annum. The gas company offered to supply gas at 4s. 9d. per 1,000 feet net, and emphasised the importance of adopting the incandescent burners, which, it was alleged, were being extensively used by large corporations in preference to electric light, even where the electric light was the property of the corporation. The electricity company's tender was accepted for 25s. per lamp.

Lowestoft.—The Local Government Board has granted the application of the Town Council for a loan of £30,000 for the purposes of electric lighting.

Maidstone.—The Maidstone Urban District Council has adopted the scheme put before it by Messrs. Stevens & Barker for lighting the streets with electricity, and application is to be made to the Local Government Board for sanction to borrow the money necessary to carry out the work.

Mersey Docks.—The Docks and Harbour Board has resolved to provide electric lights at the Union Dock and at the Herculaneum and Herculaneum Branch Docks, with the necessary additional plant, at an estimated cost of £1,000.

Montrose.—At a meeting of the Town Council, a letter was read from the Angus Electric Light and Power Company, informing the Council that the specifications for the lighting station were now in draft, and asking the Council to appoint one of their number as an *ex officio* director of the Edmundsons Electricity Corporation in terms of the agreement between that company and the town. The Dean of Guild Hall was appointed a director.

Morecambe.—The District Council has decided to carry out considerable extensions to meet the growing demand for electrical energy, at an estimated cost of £22,403, and will apply for the sanction of the Local Government Board to borrow the sum named. The electrical engineer is to advertise for tenders for an economiser and sub-station.

Newcastle.—The Tyneside Electric Power Company has been formed locally for the purpose of supplying electric energy in all the following localities:—Blaydon-on-Tyne, Wickham, Felling, Hebburn, Ryton, Willington Quay, Gosforth, Wallsend, Walker, Newburn, Benwell and Fenham, Seghill, Cramlington, Bedlingtonshire, Westslade, Jarrow-on-Tyne, Gateshead-on-Tyne, Boldon Colliery, Boldon, Monkton, Longbenton, Tynemouth, and South Shields. By working on this extensive scale it is anticipated that the Tyneside Company will be in a position to remuneratively supply electric power at much lower rates than have hitherto been found practicable. The original capital of the company is £100,000, divided into 10,000 shares of £10 each. The secretary is Mr. James Patterson, whose office is at 38, Granger Street West.

Nuneaton.—The directors of the Nuneaton Electric Light Company have accepted the offer of the District Council to purchase the works at £5,000, and a town's meeting has been called to consider the question.

Partick.—Several of the Commissioners have received a deputation from the ratepayers with regard to the electric lighting of the burgh, and the feeling has been expressed in the various wards and by the people generally that the electric lighting scheme should be proceeded with.

Penzance.—The Town Council has decided to hold a special meeting to consider the propriety of applying for a provisional order under the Electric Lighting Acts.

Radcliffe.—The District Council has applied to the Local Government Board for sanction to borrow £16,000 for purposes of electric lighting, and the Local Government Board has directed an inquiry into the subject.

Radcliffe.—The Local Government Board has fixed 18th inst. for an inquiry into an application by the Radcliffe District Council for sanction to borrow £16,000 for purposes of electric lighting, Colonel J. T. Marah, R.E., being the inspector appointed to hold the inquiry.

Reigate.—A Local Government inquiry was held on July 13th into the application by the Corporation for sanction to raise a loan of £25,000 for electric lighting purposes.

Retford.—The Corporation is seeking a provisional order for the supply of electric light to the borough.

Ripley.—The question of establishing electricity works at Ripley is under the consideration of the Council.

Rochester and Chatham.—The Electrical Power Distribution Company, Limited, has sent notices to both the Rochester and Chatham corporate bodies that application is to be made by it to the Board of Trade for a provisional order authorising the company to supply electrical energy for public and private purposes within the two districts.

Runcorn.—The Royal Assent has been given to the Bill confirming the Runcorn electric lighting provisional order. The order was referred to the Highways and Buildings Committee, with instructions to prepare a scheme in accordance with the order, and report to the Council.

Sheffield.—A 600-KW. inductor alternator is being erected at the electricity works by the Brush Electrical Engineering Company, Loughborough, and the engine house is to be extended so as to contain a Ferranti alternating steam generator of 1,700 H.P.

Slough.—Messrs. Laing, Wharton & Down have, through their solicitors, notified the Slough Urban District Council of their intention to apply for a provisional order for parishes and places within their district.

Southend.—A company is being formed by Mr. A. H. Gibbings, city electrical engineer of Bradford, with a capital of £50,000, to take over the Corporation's provisional order.

Southend-on-Sea.—The Town Council last week considered a detailed report from the Electric Lighting Committee, recommending that the Corporation's powers should be transferred to Mr. Gibbings, city electrical engineer of Bradford. The principal terms proposed are that Mr. Gibbings should supply electrical energy to the whole of the town for 1½d. per unit, and lay down the mains within 18 months. The discussion was adjourned.

Stroud.—The District Council is considering the question of establishing an electricity works in the district.

Sunderland.—The Town Council has adopted the recommendation of the Lighting Committee that the electricity works should be extended at a cost of £40,000.

Swanage.—The District Council has received a letter from the Camborne Electricity Supply Company, stating that it was their intention to apply to the Board of Trade for a provisional order for the supply of electricity for private and public purposes in the Swanage district. The clerk was instructed to obtain information about this company, and report to the committee.

Tavistock.—The District Council has deferred the question of obtaining a provisional order for six months.

Teignmouth.—The Parliamentary agent's accounts relative to the passage of the District Council's electric lighting provisional order for Teignmouth amounted to £258 15s. The clerk was requested to have it taxed.

Walker.—At a special meeting of the District Council on July 14th, a report was presented by the Electric Lighting Committee, which stated that the cost of the Council's Electric Lighting Bill was in all £1,936 10s. 2d. Answering a question by one of the members, the clerk said that had it not been for the opposition of the gas company, the Bill could have been obtained for £400, thus making an expenditure of between £1,500 and £1,600 unnecessarily incurred. The expenses of the members of the Council in London only amounted to £80. The report was unanimously adopted.

Walthamstow.—Colonel J. T. Marsh held a Local Government inquiry at the Town Hall on the 11th inst., into the application of the District Council to borrow £5,200 for wiring and fitting 6,600 8-C.P. lamps to private houses. Replying to the inspector, the clerk said that as the result of the recent canvass they had promises equal to 79,000 8-C.P. lamps. It was the usual course to enter into an agreement with the Free Wiring Company, but the Council preferred doing the work themselves. There was no opposition, but the inspector said the Local Government Board had only granted one similar application in all England.

Wellingborough.—The District Council has received notices of intention to apply for provisional orders from the Electrical Power Distribution Company, Limited, and the Municipal

Supply Company, Limited. After discussion it was decided to consent to the application of the Electrical Power Distribution Company, subject to a satisfactory agreement being arrived at between the Council and the company.

Windsor.—A letter was read last week from the solicitor to the Windsor Electrical Installation Company, asking for the District Council's permission to the extension of the company's powers to light Clewer with electricity. It was decided to postpone the matter for a month.

Woking.—At a meeting of the Sanitary and Lighting Committee of the District Council last week notice was received of the intention of the Woking Electric Supply Company, Limited, to apply on or before November 1st, 1899, to the Board of Trade for a provisional order under the Electric Lighting Acts, 1882 to 1890. The matter was referred to the Council, which instructed the Finance Committee to prepare a report on the same.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Aberdeen.—After a lengthy discussion the Town Council adopted the recommendation of the Lighting and Tramways Committee—that the salary of Mr. J. A. Bell, the electrical engineer, should be increased to £300 per annum.

Bardsley.—A collision occurred on the 15th inst. between an electric car and a lurry. The latter was thrown to the side of the road, while the front of the car, which was stated to have been running up hill at a speed of "several miles an hour" (!) was badly damaged. The car was full of passengers, but no one was seriously injured.

Bedford.—The Town Council on July 12th received a petition from a number of ratepayers urging the Council to construct a system of electric tramways in the borough and to Kempston. It was resolved that the Electricity Committee should report on a scheme, and that a provisional order should be obtained. At the same meeting it was decided to apply for a loan of £41,000 to extend the electricity supply undertaking, so as to render it available for the whole of the public and private lighting of the town.

Bexhill-on-Sea.—The House of Commons Committee has rejected the Bill for the construction of an electric tramway from Bexhill to Hastings, which received the assent of the House of Lords some two months ago.

Bristol.—The electric tramway extension to Arno's Vale was inspected on July 11th by Major Cardew, the Board of Trade inspecting officer. After inspecting the track Major Cardew visited the St. George power station, where the current will be generated till the company's central power station at Counterslip is completed. The inspector made a number of elaborate tests, at the conclusion of which he said he was perfectly satisfied with everything he had seen, and he gave the company authority to open the line for public traffic forthwith. The company had the whole of the new cars and staff ready in waiting at the Staple Hill depôt; these were telegraphed for at five o'clock, and before six o'clock the horse cars on the new electric tram section had disappeared, and the lines were being worked by the electric cars. The total length of line electrically operated now amounts to 10 miles. There still remains a length of 20 miles of route to be equipped, and the whole capital expenditure will amount to about £400,000. The work is proceeding rapidly, and it is anticipated that the permanent way will be finished by April next year. The feeder cables are being laid in conduits, the makers guaranteeing them to remain in good order for 10 years, if laid in this way. At the same time new car sheds and the large generating station at Counterslip are in course of construction, and every effort is being made to complete the work within a twelvemonth.

Although there are complaints that the centre poles, which the Tramway Company was compelled by the Corporation to use in Victoria Street, impede the traffic, the company will be obliged to reconstruct the lines near the Colston Avenue to suit centre poles, instead of span wires and side poles as intended.

Colne.—At a meeting of the Town Council on 5th inst., in regard to the Nelson, Colne, and Trawden Light Railway, it was stated that the opposition to the project of the Lancashire and Yorkshire Light Railway Company had been withdrawn, so that in all probability the order would now be made.

Continental Notes.—Italy.—An electric tramway is to be constructed between the railway station and the town of Chieti.

Spain.—Application has been made for a concession for a projected electric tramway between Sarria and the Montana de Vallvidrera.

Darwen.—A deputation from the Corporation visited the Glasgow tramways on July 12th, and inspected the generating station and car works.

Germany.—The American Consul at Düsseldorf has, after the fashion of his kind, lately been reporting upon the progress of electric traction in Germany, and an abstract of his report has been published in that enterprising trade journal, *Sell's Commercial Intelligence*. From this abstract we learn that all the more important German cities are now provided with suburban electric lines, and that horse traction in the central portions of these cities is being gradually displaced. As a typical instance of the network of electric lines surrounding the larger towns he takes Düsseldorf, which possesses four completed suburban lines:—Düsseldorf to Crefeld, about 12 miles; Düsseldorf to Rattigen, about eight miles; Düsseldorf to Benrath, about six miles; Düsseldorf to Kaiserwerth, about five miles. Were London as well equipped as Düsseldorf it would possess at least 100 suburban electric lines, and one of the great city problems of the moment would be in a fair way towards solution. Could not the L.C.C. spend with advantage more of its superfluous energy upon study of this aspect of the "over-crowding" problem?

Halifax.—The electrical engineer to the Corporation (Mr. Street) has presented to the Council a lengthy and exhaustive report in regard to the future requirements of the municipality, under the altered conditions since the construction of the tramways. He says that as to whether the present alternating system of supply of electricity is still suitable, under the altered conditions of working since the operations of the tramways, the question depends mainly on the extent the Council proposes to extend the tramway system. He says:—

"For the purposes of lighting alone the superiority of alternating current supply or direct current supply is a matter of personal opinion, based on experience, and seeing how large a number of central stations of either system are in successful operation in this country, it cannot be said that either the one or the other is unsuitable, the only moot point is—which is the easier to work? The question in general was decided when your central station was built some years ago, and from the geographical conditions existent in Halifax, preference was undoubtedly given to what was then the more suitable system. Recently, however, conditions have altered to such an extent that the present is a very proper time for the reconsideration of the question. Among recent improvements, the introduction of a good high voltage lamp ranks first. This has removed the great disadvantage under which direct current systems had been working, *i.e.*, cost of distribution, which has been reduced 50 per cent.; of course it has also favourably affected alternating current stations, but in a lesser degree. Plant and switch gear have also improved, and for cables several reliable substitutes for rubber have been brought out. Accumulators also have made big strides towards perfection, from which, however, they are still a long way. These improvements have all tended to bring the direct current system more into favour. But if ever a reliable battery is brought out which will store electricity in the same proportion as gas is at present stored in your gas-holders, it will of necessity be for direct current, for it is a physical impossibility to store up alternating current. In many cases now, an engineer, when deciding on the system to be employed, would consider direct current more suitable, when a few years ago the alternating current alone could have been used. The question before the Committee is this: Are you justified in now changing over part of the system from alternating to direct current, seeing conditions have so materially altered during the last few years? But, at the outset, a serious difficulty is apparent. Five-sixths of the present lamps installed are within a radius of 500 yards from Cheapside. Consequently, if this area is changed over to direct current, three-fourths of our present plant, viz, the two large 600-H.P. alternators, would be useless for lighting purposes. They could, however, be re-arranged so as to work as tramway power generators. If an extended tramway service is brought forward, there will of necessity be required several sub-stations several miles out of Halifax, and these must be supplied with power by means of polyphase distribution with polyphase generators in the central station in Foundry Street, for this is the only method of working long distance tramways, and the committee would have to purchase an outfit. As an alternative, I would lay before you the following scheme:—You are aware that at present electricity for lighting is generated at high pressure, 2,000 volts, at Foundry Street, and transformed, by means of transformers fixed at suitable points in the town, to a low pressure, 200 volts, which goes to the lamps. Houses outside the area supplied have, in nearly all cases, small transformers fixed in their basements. It is suggested that the area should be supplied with direct current, which does not need transformers, and would result in releasing all these large transformers for other work in more distant parts of the town. The network of cables which run through the district shown was laid down with ample margin for an increasing demand, but progress has been so rapid that these cables will soon be loaded up, which will necessitate either extra cables and extra sub-stations, or doubling the pressure on the mains, and thus doubling their capacity and altering all the lamps. This overloading will have to be dealt with within the next two or three years, and could be very well done at the present instance. So the committee have now to decide if they will (1) convert the two 600-horse-power alternators, at an estimated cost of £1,000 each, into tramway power generators, and put down new plant for lighting the centre of the town; (2) change the standard pressure from 100 to 200 volts, thereby doubling the capacity of the low tension network; and (3) relay these cables in bitumen, thereby more than doubling their life. As before mentioned, these last two matters will have to be met, even if the alternating system is proceeded with, and new alternators must be bought at once. If the system were changed, and new direct current machines obtained, these could be used either for tramway or lighting work. But whatever your decision, I wish to impress upon the committee a most vital point with regard to central stations, a point which cannot be too strongly emphasised, and it is that, to

secure good and successful running, all future machinery should be alike as near as possible, in size and make, for 'uniformity of plant' is an axiom which cannot be carried to excess. Do not, if you have an odd corner in your station, buy an odd plant to fit in; it is a policy which will be regretted sooner or later; you could erect a building for £4,000, which would hold £150,000 worth of plant, and if this plant is uniform, the cost and time of repairs are reduced to a minimum, while the appearance of the station is vastly improved. I need hardly point out what a profitable source of income could be obtained by combining a tramway and lighting station in outside districts, worked by multiphase motors from Foundry Street, and in my opinion the deciding of the question on which this report is based should depend on what decision (*re* tramways) the committee are able to come to with these districts. I consider it advisable to lay before you the necessary expenditure which will occur during the next three years to meet the rapidly increasing demand, and supposing the alternating current supply is proceeded with. Out of the five existing sub-stations, four are very much overloaded, and the transformers must be increased, and feeders doubled. The feeders which supply the outlying districts are at present all joined to one trunk main, and should now be split up into sections and two extra trunk mains laid between George Street and the works. The cost of this will be as follows:—Alternator switchboard, £200; six feeder panels at £45, £270; six pairs feeders, at £140, £840; 20 kw. transformers, at £53, £1,060; fittings and wire at sub-stations, £130; pipes for feeders, and laying same, £420; total, £2,920. This will suffice for only three years. If the direct current system were adopted the amount of copper to be laid from the works to the existing sub-stations, in order to supply our existing lamps, plus the number allowed for its estimate No. 1, and with a very large margin, would be 42,500 lbs., at 9d. per lb., £1,594; (2) cost of conduits and insulation material, and laying same, £800; (2*a*) switches at sub-stations, £60: total, £2,454. These mains will carry 1,000 amperes to each sub-station, or four times what we are already supplying, and if the standard pressure be doubled, then these feeders will carry enough current to meet the demands in the centre of the town, even if nearly every house has the electric light. I may again say that even if the alternating supply is proceeded with, the cables laid in the streets, shown on map, will soon be overloaded, and either new sub-stations should be built or new feeder cables run to relieve them, or the pressure doubled. In the case of either system the cost to us would be the same, for we should have to exchange all the lamps in the district, of which there are about 16,000. (3) 16,000 lamps at 10d. each, £666. We could retail a lot of these lamps to consumers in the outskirts of the town at 6d. each. There are about 16 private alternating current arc lamps in the town; these would have to be changed to direct current ones where possible, but the old ones would be used for public lighting in the outside districts. Also the few small alternating motors could be let on hire. The proposed change to direct current would release transformers and switchboard fittings at present fixed in the Town Hall, George Street, Markets, Wards End, and Woolshops sub-stations, to the value of about (4) £1,200, all of which could be in time used up in the small but rapidly increasing sub-stations in outside districts. You will notice that the difference of cost of sub-station fittings, &c., for alternating current and direct current is £1,200 and £60 respectively. See estimates, Nos. 4 and 2*a*. So that, bearing in mind that engines and dynamos for supplying alternating current cost practically the same as those for direct current of equal power, the necessary immediate outlay, not allowing for engines and dynamos, will be estimate No. 1 (alternating) for three years, £2,920; estimate No. 2 (district current), £2,454; switchboards at works, boosters and balancer, £700; total, £3,154, less estimate No. (4), £1,200; leaving, £1,954; plus estimate No. 3, £666; total, £2,620. I have only added estimate No. 3 to the direct current scheme, as it is absolutely necessary to this scheme, but could be dispensed with for a time in the alternating current scheme. The direct current trunk mains are practically unperishable. I am assuming that our large battery will be of great use to us in this scheme, which is fortunate, as it is already too small for tramway work, except as a balancer, owing to the rapid growth of the tramway system. It will not be much good to take the top peak of the lighting load, though it could help. I may here say that the prime cost, efficiency, and up-keep of an engine and dynamo would be less than that of a battery, though a battery in some cases is invaluable. With regard to a question raised by a member as to reserve plant required in a station, if the standard unit in a station is 800 H.P., there must always be an 800 H.P. set in reserve. If there are enough lamps connected to fill up either one H.P. set or 10 800-H.P. set, the reserve plant is always the same, viz., one 800-H.P. set. Our small tramway sets will soon be of little use, owing to the increase of the tramway system, but these could be used for the varying lighting loads; and, of course, if the committee adopt the direct current, their new machines could be used for lighting or tramway work. The question of the low tension network of mains is a very important one. In this case it is proposed to double the pressure between the outer wires and earth the inner. The makers, while they think the mains should stand this, would not guarantee it. Personally, I do not think there is much risk at present, and if there were a breakdown it would not be a serious matter. But bearing in mind that the life of a rubber cable is by no means long, say, eight years, it would be a good plan to re-lay the existing mains in the district shown on the map, bedding them in bitumen. They will then be practically unperishable, and though I estimate the cost to be £1,400, including labour, &c., I consider the money will be well spent. In conclusion, I may say I have made this report with great diffidence, not wishing, so soon after my appointment as your electrical adviser, to make changes of so revolutionary a character as this report sets forth, but I cannot help admitting, and my opinion is shared by men of the highest standing in the electrical profession, that in a few years' time no new single phase alternating current stations will be laid down, and signs are not wanting of a tendency to convert these stations before they get too large. Undoubtedly the station of the future will be a large polyphase generating station, with direct current distributing stations containing rotary converters, the former being placed in a position for the easy handling of coal and with a good water supply near, and your Foundry Street station is most admirably situate for both these. And as the demand for light in Halifax increases, the direct current supply will gradually extend and absorb the districts that are at present fed with alternating current, and eventually sub-stations equipped with polyphase machines driven by polyphase motors, actuated by the polyphase generators in Foundry Street, will be erected in some part of Skircoat, Highroad Well, and Ovenden, which will supply the districts near each." The recommendation of the Gasworks and Electricity Committee was approved that part of the centre of the town be supplied with direct current, and machines which can be used for either lighting or tramway purposes.

Halifax.—A special meeting of the Town Council was held on July 12th, when the recommendations of the Tramways Committee—that powers be obtained to construct electric tramways on nine specified routes, at an estimated cost of £160,000, or about £8,000 per mile—were adopted. Further, the Council added four routes which had been rejected by the Committee! It was stated that the whole system would be completed within five years.

Laxey-Ramsey.—On July 13th, Messrs. T. Fisher, J. Cowle and R. Corlett, arbitrators appointed by the Governor, sat at the Court House, Douglas, to assess the value of certain lands acquired by the Isle of Man Tramways and Electric Power Company, Limited. The matter was adjourned.

Leeds-Yeadon.—The Joint Tramway Committee appointed by the District Councils of Yeadon, Rawdon, and Horsforth, met at Rawdon on 14th inst., and formulated a scheme of tramways from the Leeds city boundary at Kirkstall to Yeadon, which is to be submitted to three private firms, to see how far they are prepared to carry it out.

Liverpool.—At a meeting of the Tramways Committee on July 14th it was stated that great loss and inconvenience had been caused by the failure of the contractors to deliver the electric cars, of which only five out of 20 had been received. There are altogether 80 cars on order. The engineers were asked to report on three proposed new routes.

London County Council.—The Council on July 18th decided to instruct the Parliamentary Committee to seek powers in the next session to authorise the Council to adopt on the tramways the conduit, trolley, or surface contact system of electric traction.

A New Tramway System.—Mr. A. F. Stevenson sends us a description of a new electric tramway system, which he terms a combination of the underground conduit and surface contact methods. He effects the combination by enclosing a simple mechanically operated surface contact in a small conduit, and claims to get a system which is sightly, safe, and inexpensive. It is known as the Heyl-Dia electric tramway, and the patents are the property of the English Industrials, Limited, of Manchester. In this system the conduit, which is only 6 inches deep and 3½ inches wide, is formed by riveting a stout angle iron of special shape on the flange of one of the ordinary rails, the space between the rail and the angle iron being the conduit. The slot of the conduit is ⅝ inch wide. At intervals of 24 feet contact boxes are let into the angle iron, which are operated by a flexible plough, 26 feet long, stayed from each end of the car truck. The contact box consists of a watertight cast-steel chamber (6 inches × 6 inches × 5½ inches) in which is pivoted a horizontal switch arm. One end of the switch arm, which is fitted with a small trolley, projects into the conduit through a flexible diaphragm of leather, rubber, or other suitable material. The other end of the switch arm lies midway between two contacts, which are in connection with the feeding cable. The body of the plough consists of a steel strip 26 feet long and 2½ inches deep, to which is attached, by insulating blocks, a conducting strip of phosphor bronze, which extends the whole length of the plough. The *modus operandi* is as follows:—The contact strip, coming into contact with the trolley at the end of the switch, knocks it over till the other end engages with one of the contacts in the box. Electrical connection is thereby established between the feeding cable and the contact strip, which again is in connection with the motors, &c., on the car. After the car has passed, the switch arm is brought back to the insulated position by a spring. If the car is travelling in the other direction the arm goes over to the opposite contact. One of the main features claimed for this system is its high insulation. The only point at which a leakage can take place is the contact under each car. The rest of the conduit is dead. At first sight it might seem that there was considerable danger of the strip coming into contact with the walls of the conduit, but we are given to understand that this is prevented by the plough body, which would come against the sides of the slot long before that happened. The stays and guide wheels keep the plough in a vertical position and also in the middle of the conduit. Sump holes are let into the conduit about every 100 yards, the conduit being cleaned out by attaching a scraper to the plough of a car.

Plymouth.—The "Three Towns," Plymouth, Devonport and East Stonehouse, had an opportunity recently of buying out the company which owns and works the horse tramways which connect the towns, and of equipping the service for electric traction. They did not do it because of local jealousies respecting the division of the anticipated profits. Now the company are themselves prepared to undertake the work of bringing the service up to date, and

in harmony with the municipal tramways in other parts of the towns. Unfortunately there seems to be serious danger of this scheme being also wrecked. The East Stonehouse District Council declines to discuss it, and as the District Council holds the key of the situation, the two Corporations of Plymouth and Devonport are practically helpless in the matter. If East Stonehouse continues obdurate, it is likely to be swallowed up by one of its bigger neighbours; but when Plymouth tried this remedy for these domestic differences a few years ago the Local Government Board would not consent.

The Board of Trade has sanctioned the loan, for which the Plymouth Corporation recently applied, for the purpose of extending electric traction in the borough. The Prince Rock section of the electric tramway will, it is expected, be opened this month. The application of the system to the Compton line will commence as soon as certain street improvement works are sufficiently advanced to give the necessary road space.

Rhymney.—The directors of the Rhymney Railway have decided to equip their new works at Caerphilly in the most modern manner. Electricity will be adopted for the transmission of power as well as for lighting purposes. A complete system of electric lighting will be installed, and electrical motors will be used throughout for driving the machines in the fitting shops and carpenters' shop. The lifting and walking cranes will also be worked by means of electrical motors. The dynamos and motors will be manufactured by Messrs. J. H. Holmes & Co., of Newcastle-on-Tyne, and the whole of the erecting and fitting up will be carried out by Messrs. J. B. Saunders & Co., electrical engineers, Cardiff.

Rothesay.—A special meeting of the Council is to be held to consider the proposal for the purchase of the Rothesay Tramways Company by the British Electric Traction Company. Notice of motion has been given that the Town Council take over the tramways.

Ryde.—The Town Council has decided to support the proposed light electric railway scheme to Sea View.

St. Helens.—The electric tramways were inspected by Major Cardew, on behalf of the Board of Trade on July 19th, with satisfactory results.

Seven of the contracts for the important extensions in view have already been let, and the work of relaying the tramways has been commenced.

Stourbridge.—At a special meeting on July 11th, the Council authorised the Tramway Committee to make the necessary arrangements with the British Electric Traction Company as to the details of the carrying of the tramway up High Street, as authorised by the Dudley and District Light Railways Order.

Washington, U.S.A.—A plan is being considered by the Post Office Department for the introduction of automobile mail waggons in place of the horse-drawn vehicles now employed for collecting mail matter in the business section of the city. An electric vehicle, it is said, could easily be adapted for the work, and in addition to carrying storage batteries for its own power, an electric automatic cancelling machine could be placed in the waggon, providing better facilities for postmarking letters than the present method of hand cancellation. At present several clerks are employed on the mail collection waggons for cancelling and postmarking letters, and with the introduction of the automatic machines, which are used in the city post office, a considerable saving of time and labour would be effected. It is urged that the automobile could be charged from the electric plant of the post office building, and that better time and service would be the result in the collection of mail matter.

Worcester.—The report of Messrs. Kincaid, Waller and Manville, the experts appointed to advise the Corporation as to the advisability of acquiring the present system of tramways and converting them for the use of electric traction, has been placed before the Streets and Electricity Committee. The engineers estimate the cost of acquiring, extending, and equipping for electric traction the present tramways at £72,000, and the working, in their opinion, after meeting all charges, would result in a net profit to the city of £2,834 per annum. They advise that steps should be immediately taken to oppose the proposals of the tramway company to obtain powers to retain possession of the tramways.

TELEGRAPH AND TELEPHONE NOTES.

Edinburgh.—The directors of the Chamber of Commerce have forwarded to Sir Lewis M'Iver, M.P., for presentation to the House of Commons, a petition against the Telephone Bill. The petition says that the directors cannot regard the Bill as amended by the Standing Committee on Trade as being in any way a solution of the difficulties which the system existing in the country presents, and that they are of opinion that the true solution of the whole question lies in the nationalisation of the telephones.

Royal Electric Bells.—It is reported that the National Electric Company, of Milford (Connecticut), has made a contract to furnish Windsor Castle with electric bells and fire alarms, in competition with 50 English, French, and American concerns. When this order has been carried out, all the Queen's residences are to be fitted up in the same way. And by the same firm may we ask?

Government and the Telephones.—A basis of agreement has been arrived at between the Government and the National Telephone Company on the one point left by the Grand Committee on the Telephones Bill; this is as to the terms of intercommunication between the subscribers of the new and the old exchanges. It appears that the new exchanges will have free communication with the old ones when they have secured half the telephone users in an area of competition, and in the meantime the new exchange will pay to the old one a fee of 1d. a call. It is also pointed out that the free communication, when it is reached, will of course benefit the old company as well as the new exchanges, as it will be reciprocal.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Amazon Company's cable—		
Cable beyond Gurupa ...	April 4th, 1898 ...	...
Jamaica-Colon	July 1st, 1899 ...	...
Bonny-Cameroun	May 29th, 1899 ...	...
Latakia-Cyprus	June 21st, 1899 ...	...
Para-Maranham	April 10th, 1899 ...	...
Landlines.		
Communication between Salonika and Monastir ...	March 23rd, 1899 ...	...
Communication with Swakopmund	July 11th, 1899 ...	...
Moulmein-Bangkok... ...	July 18th, 1899 ...	...

Wireless Telegraphy from Balloons.—The Austrian military balloon section on July 11th made some interesting experiments, in which for the first time it was attempted to communicate between two balloons on the Marconi system of telegraphing without wires. One station was fixed to the car of a captive balloon, while the second was placed in a free aerostat. Notwithstanding the fact that, on account of the movement of both cars, the apparatus could not be fixed with the same accuracy as in a stationary position, despatches were exchanged with satisfactory results for some considerable time. Occasionally the signals were not clear, and some interruptions also occurred, but, on the whole, the outcome of the experiments was such that the military balloon detachment has resolved further to study and perfect the system.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barcarrota, Spain.—July 31st. The municipal authorities of Barcarrota (Badajoz province) are inviting tenders until the 31st inst. for the concession for the electric lighting of the town during a period of 10 years. Particulars may be obtained from, and tenders be sent to, El Secretario del Ayuntamiento de Barcarrota (Badajoz).

Battersea.—August 31st. The Vestry wants tenders for an overhead travelling crane (hand or electric), and batteries for the electricity works. See "Official Notices" July 7th.

Belfast.—July 31st. The Harbour Commissioners are prepared to receive tenders for the conversion of a 2-ton jib crane from steam to electric power. See "Official Notices" this week.

Birkdale.—August 19th. The Urban District Council invites tenders for the transfer of its electric lighting powers.

Denbigh.—The North Wales Counties Lunatic Asylum Committee wants tenders for the supply of engines, dynamos, switchboard, injector, piping, and foundations, also wiring of buildings for electric lighting. See "Official Notices" July 7th.

Edinburgh.—July 31st. The Council wants tenders for coal measuring gear and extensions to shafting, &c., for driving mechanical stokers. See "Official Notices" July 14th.

Glasgow.—July 22nd. The Corporation wants tenders for boilers, steam engines (main and auxiliary), three-phase generators, continuous current generators, rotary converters, boosters, and static transformers, surface condensers, feed pumps, circulating pumps, and air pumps, all for the electric traction scheme. See our "Official Notices" June 23rd.

Glasgow.—July 22nd. The Corporation wants tenders for 80 electric tramcar bodies to sample and drawing. See "Official Notices" June 23rd.

Glasgow.—July 31st. The Corporation wants tenders for the supply of concentric and single lead-covered main cables. See our "Official Notices" July 14th.

Glasgow.—August 2nd. The Corporation wants offers for the electric work required in connection with its fire alarm and A B C telegraph systems. Specifications, &c., from the chief officer of the Fire Brigade, College Street.

(*Continued on page* 110.)

ST. HELENS CORPORATION ELECTRICITY WORKS AND TRAMWAYS.

The Corporation of St. Helens made its *début* as an electrical undertaker nearly three years ago, when a provisional order was obtained by the Gas Committee, and a generating station was put down to the specifications of Mr. Robert Hammond on the alternating current system, with transformers in street boxes; we published a description of the plant in our issue of January 22nd, 1897. The alternators were two in number, one of 120 KW., and one of 25 KW. output; but the demand rapidly increased, so that last year there were 6,000 lamps connected, the plant was fully loaded, and there was no stand-by—but, we are pleased to add, neither was there a breakdown.

Instead of extending the alternating system, the Corporation, having in view the desirability of electric traction, and the fact that the tramway lines were their own property, instructed the late Dr. Hopkinson to draw up a scheme for a combined lighting and traction works on the direct current system. Dr. Hopkinson's report was adopted, and after Major Cardew had held an inquiry, the Board of Trade on April 27th, 1898, sanctioned a loan of £25,000 to carry out the work of constructing and equipping the tramway and generating station.

On the lamented death of Dr. Hopkinson, the resident electrical engineer, Mr. J. S. Highfield, was appointed electrical engineer to the Corporation. Since then the work has been rapidly pushed forward, and on July 5th the members of the Town Council made a trial run over the section of the line which has been completed, with entire satisfaction.

The works are situated on a large vacant space at Boundary Road, and share with Ashton the distinction of combining electric light and power supply with electric traction and refuse destruction; further, almost the whole of the plant and equipment is of English manufacture—a most healthy symptom of progress.

The buildings were erected by Messrs. John Rothwell and Sons, St. Helens, and comprise general offices, engine and boiler houses, destructor works, and car sheds.

The boiler house is situated immediately behind the engine room, while the economiser is conveniently placed in a shed adjoining the boiler house. The boilers, of which at present two have been installed, are of the Lancashire type, 30 feet long × 8 feet diameter, and are worked at a pressure of 160 lbs. per square inch; they were made by Messrs. Yates & Thom, who supplied almost the whole of the steam generating and distributing apparatus. The stop valves, isolation valves, and high and low water alarms, are of Hopkinson's make; the dead-weight safety valves are by Turnbull, the gauges and blow-off cocks by Dewrance.

Immediately behind each boiler is a superheater, made by

Fig. 1.—General View of Engine Room; Booster-Balancer in Foreground.

Messrs. Musgrave & Sons, Limited, Bolton, and capable of giving a superheat of 120° F. This apparatus consists of a tube plate bolted to a cast-iron box, in which are placed an outlet and inlet for the steam; tubed into the plate are a number of solid drawn steel pipes, arranged in a U form, which are placed in the down take at the back of each boiler. Each superheater is fitted with a safety valve and two drains and thermometer pockets. After passing through the superheater the gases flow under the centre of the boiler, returning by the sides and away to the economiser.

The superheater adds only about 1 foot to the length of the boiler space, and is so constructed that after breaking two joints it can be bodily lifted from its setting (fig. 2); to facilitate this operation, a light girder is provided over the superheaters, on which a trolley runs to support the lifting tackle. The weight of the apparatus is about 2 tons.

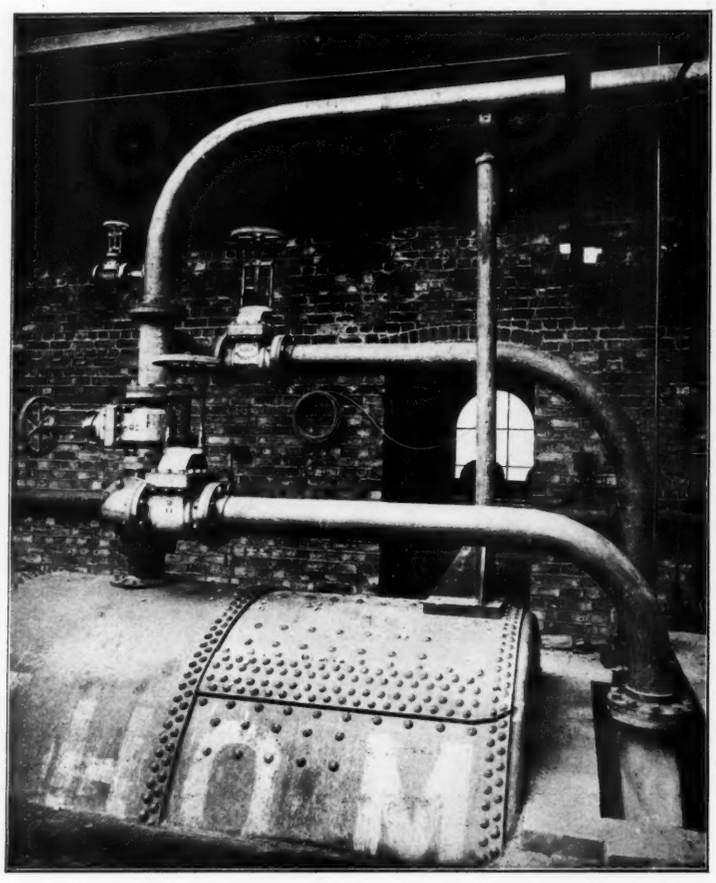


Fig 2.—Arrangement of Superheater and Steam Pipes.

The economiser, of Green's manufacture, consists of 240 9-feet tubes; the scrapers are driven by a small Lundell motor. The usual bye-pass flue is provided.

There are two steam feed pumps, of Green's double ram fly-wheel type, each capable of delivering 12,000 lbs. of water per hour, either direct or through the economiser. The steam pipes to the pumps are in duplicate, while the feed pipes form a ring. A tell-tale pressure gauge is fixed on the feed pipe leading to the economiser, to record the maximum pressure at which the pumps are worked. An injector is provided as a stand-by, made by Messrs. White, of Salford; this injector is self-starting, and is controlled by a single valve, which also acts as a regulator.

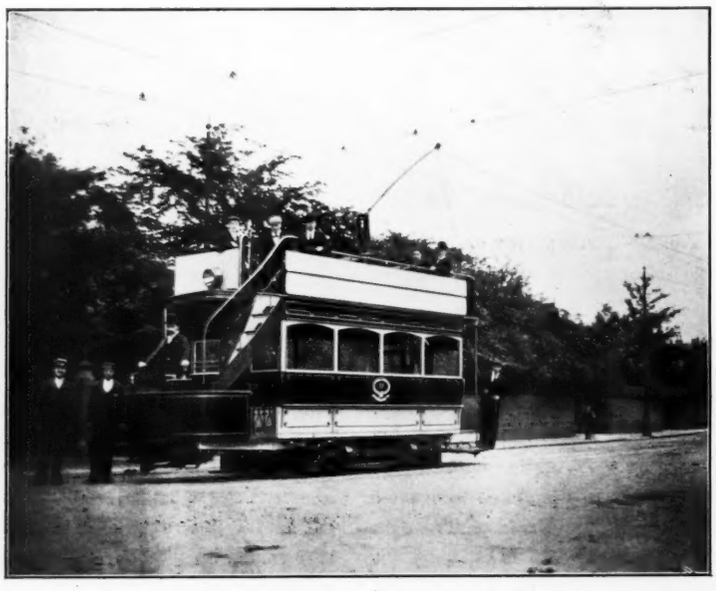


Fig. 3.—Car on Line.

We noted with approval that the steam range consisted of a single main to the larger engine sets; there is, however, a duplicate steam supply to the small sets, the pipes for which are so arranged that they may be supplied—(1) from the main boilers, (2) from the destructor boilers only. The object of this is partly in order to obtain an exact knowledge of the value of the destructor as a steam producer. A valve is also provided, by means of which the destructor steam can be admitted direct into the main steam pipes, if desired.

The Lancaster steam traps are used all over, and the pipe joints are made with Taylor's packing rings; the pipes are lagged with plastic cork, supplied by Messrs. Lonsdale Bros., Blackburn.

The condensing and cooling plant consists of a Wheeler surface condenser, mounted on the steam-driven air and circulating pumps, and a Klein's patent cooling tower. The condenser is of the Wheeler standard Admiralty pattern, with a condensing surface of 850 square feet. The tubes are of brass, solid drawn with one end thickened; this is screwed into one of the gun-metal tube plates, while the plain end is held in the other tube plate with the usual screwed ferrule and corset lace packing. The air and circulating pumps have pistons 10 inches in diameter, the steam piston is 8 inches in diameter, and the stroke of all three is 12 inches; the pumps are of the horizontal type, and are very compactly arranged. The condenser is capable of condensing 8,000 lbs. of steam per hour. As the condenser is situated in a chamber beneath the floor of the engine room, it could not be photographed.

The cooler, which was manufactured by the Klein Engineering Company, Limited, Manchester, is designed after the chimney principle, producing a natural draught without waste of power, and occupying a very small area of ground (fig. 5); there are no moving parts. The tower is carried to a height of 50 feet to prevent nuisance from the vapour which escapes from the top, but the cooling stack inside the tower is only

20 feet high; this is the maximum height to which the water must be lifted. In order to use the condensed steam for feed water, the steam is passed through a Klein

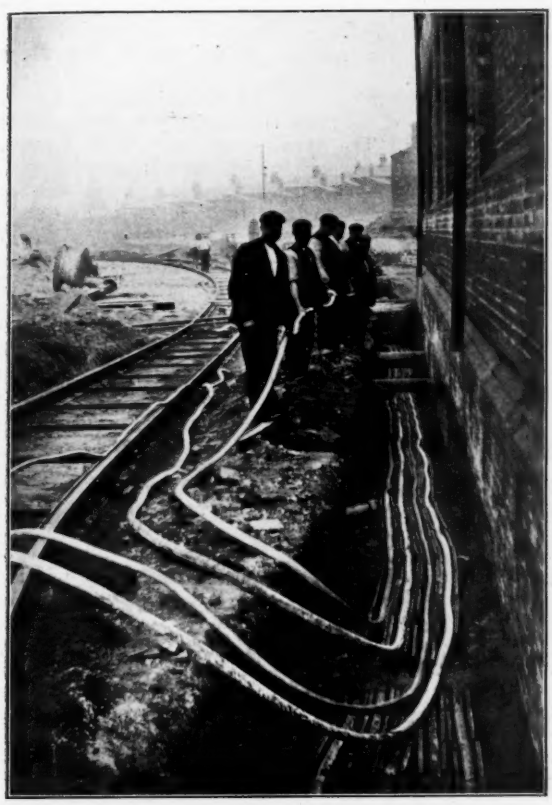


Fig. 4.—Laying the Feeders.

oil separator on its way to the condenser; this works on the principle of changing the direction and velocity of the steam, and so throwing out the oil, which is collected in the bottom of the separator. The water from the condenser is led direct to the hot well, from which it is drawn by the feed pumps.

There is an automatic relief valve to give free exhaust to the atmosphere if, from any cause, the vacuum should fail.

The chimney stack is 200 feet high, and about 6 feet in diameter at the top; it is lined for part of its height with fire-brick.

The generating plant at present comprises four coupled sets, each of which consists of a Willans & Robinson three-crank compound engine coupled to a Mather and Platt four-pole shunt-wound dynamo. The two larger engines are of the 3 P type, running at 360 revolutions per minute, and provided both with throttle governors and with automatic expansion gear. Between the engine and the dynamo is an extremely massive fly-wheel, of which we give a cross-section (fig. 6), and which weighs over 8 tons; the diameter of this fly-wheel is 5 feet, width 2 feet 2 inches, and it is arranged so as to form part of the rigid coupling between engine and dynamo.

The output of each engine is 310 I.H.P. at full load; the steam consumption specified was 16¼ lbs. per I.H.P.-hour, but under test the value was found to be 15½ lbs. condensing. The engines are capable of carrying an emergency load 25 per cent. greater than the normal full load, and by reason of the combination of throttle and expansion governing are able to maintain a high efficiency under wide variations of load.

The larger dynamos are rated at 195 KW., the maximum current being 390 amperes, while the pressure can be varied from 450 to 575 volts. The yokes are of cast-steel, and are separate from the bedplate, which is of the open type; the faces of the pole-pieces are laminated. The armature core is carried on a spider, allowing of ample internal ventilation. The armature is wound with two layers of solid bars laid in deep slots, which are partially closed at the periphery; wooden keys, driven into the slots over the bars, hold the latter in place. The winding is of the drum type, with cylinder end-connections, carried on an extension of the spider. The commutator lugs are slightly waved or corrugated, so as to be flexible. The brush-holders are carried on two complete rings, which are supported by the commutator-end bearing, and are simultaneously rotated by a screw feed; the brushes are of carbon. The bearings are provided with automatic ring lubrication, and in spite of the great weight of the fly-wheels, have never given any trouble by heating. The smaller sets are generally similar to the large ones, but the outputs are:—Engine 180 I.H.P. at 450 revolutions per minute (220 I.H.P. on emergency); dynamo 112·5 KW., 230 amperes at 450—575 volts. The engines are of the 3 O size, with fly-wheels weighing 4½ tons each.

The 10-ton travelling crane was made by Messrs. Higginbottom & Mannock, of Manchester, and is worked from platforms attached to the crane itself; the crane hook is mounted on ball bearings so as to swivel with ease.

A combined balancer and double booster forms an interesting feature of the engine room, and is well seen in our general view (fig. 1). This machine consists of two double-wound armatures coupled together, and having four commutators. The field magnets are both excited off the outers of the lighting mains, at about 470 volts; the balancer armature divides this into two circuits of 235 volts each, with a maximum load of 35 amperes, and runs at a speed of 625 revolutions per minute. The booster armature, which is driven by the balancer, is designed for a maximum current of 200 amperes, and generates a pressure of 40 volts

Fig. 5.—Cooling Tower.

in each circuit. The two windings can be put in parallel or in series, giving a "boost" of 40 volts with 400 amperes flowing, or 80 volts with 200 amperes, respectively. Moreover,

the polarity may be reversed, so that the "boost" is up or down at pleasure. The combined over-all efficiency of the two machines, when the balancer is acting as a motor and driving the booster, is 80 per cent.

The engine room is ventilated by two Gibbs' electric fans, one at each end.

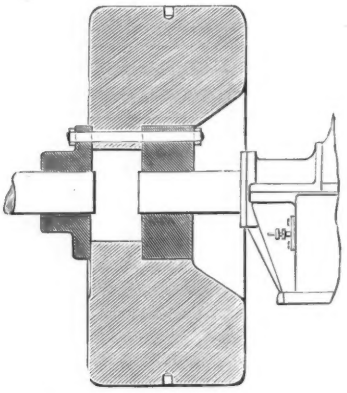


Fig. 6.—Details of Fly-wheel.

The storage battery consists of 250 cells made by the Chloride Electrical Storage Syndicate, Limited; each cell consists of 25 plates in a lead lined box, and will give 450 amperes for one hour without the terminal pressure falling below 1·85 volts during the passage of the current. A peculiar feature of the battery is that there are no regulating cells or switches; the battery is to be used *en bloc* at all times.

The most prominent feature of the switchboard is its extreme simplicity—not only in front, but also at the back. The system adopted is in brief as follows:—There are two station pressures; one for the feeders in which the drop is greatest, and one for the feeders having a smaller drop. There are two positive and two negative bus bars corresponding with these two pressures, and each feeder is brought to a two-way switch, by means of which it can be connected with the bus bar which is at the most nearly correct pressure. The battery is not used as a balancer, but is always connected with one or other set of bus bars; and the second pressure is obtained by means of the booster, which is used *either to raise or to lower the pressure*, as may be required. We would point out in passing, that in the latter case the booster is *motoring*, and that the reduction in pressure is not accompanied by a loss of power; this is true also of "back E.M.F." cells, provided that the latter are usefully discharged at proper intervals, but in how many instances where they are used is this carried out? We commend this method to the notice of engineers as a means of regulation; it has been applied already in electric traction, where a separate booster may sometimes with advantage be provided for each feeder, but we do not recollect any instance where the system has been employed for electric lighting in this way.

The control of the booster is effected by means of a regulating resistance in the field-magnet circuit (excited from the bus bars) and a small reversing switch in the same circuit; in order to change from boosting up to boosting down, the field current is first reduced to a very low value by means of the resistance; the reversing switch is then thrown over, reversing the polarity of the magnets and consequently the direction of the booster E.M.F., and the field current adjusted to give the proper boost. This controlling gear could be covered by a single page of foolscap!

The performance of the battery is recorded by a special Aron watt-hour meter, which is provided with two dials; on one of these the energy input is registered, on the other the output. As the battery is never joined to the middle wire except when the load is very small, the meter error due to want of balance is trifling; moreover, the whole of the lamps and motors used in the works can be thrown on either side of the system by means of a two-way switch, and as there is a considerable load of this kind, a valuable aid to balancing is in this way obtained.

An Aron watt-hour meter is provided to record the output of each machine.

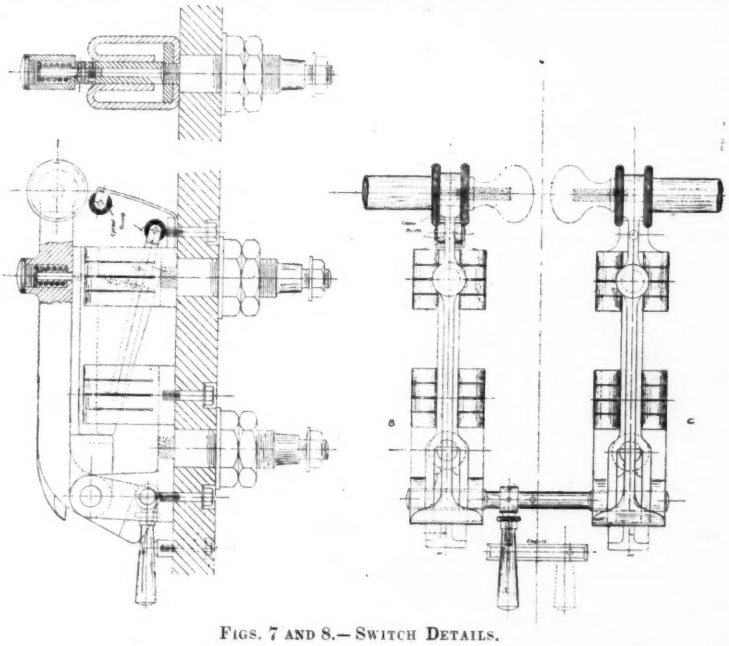
We cannot describe the lighting switchboard apart from the traction board, as there is necessarily a close relation between the two. The dynamos are intended to be used indifferently on either system; but each is provided with two double-pole switches which are interlocked, so that when a dynamo is coupled to the traction mains it cannot possibly be simultaneously thrown on the lighting mains, and *vice versâ*. We give in figs. 7 and 8 detail views of these main switches, which it will be seen are of the knife type with quick break and carbon break.

Considered more in detail, the lighting switchboard consists of six panels of white marble, arranged on a gallery at one end of the engine room; from the gallery a door opens direct to the top of the boilers, so that the gallery forms a central point from which practically the whole works can be readily supervised and controlled.

The first panel on the left hand is the battery panel, bearing the booster shunt regulator and reversing switch already mentioned, a main circuit reversing switch, a series parallel switch for putting the two booster windings in series or in parallel, a double-pole switch and fuse for the battery, single-pole switch in the battery positive, and a double-pole switch to put the battery in series with the booster. The instruments on this panel are:—Battery voltmeter (600 volts), booster voltmeter (120 volts), and a battery ammeter (450 amperes), which reads both ways.

The next two panels are for the positives, and are fitted with two large horizontal bus bars on the front. Each feeder is joined through an ammeter shunt to a two-way switch connected with the two bars, so that the feeder can be thrown on either bar; the battery and dynamo leads are joined to five vertical bars on the back of the board, which can be connected with either of the bus bars by means of screw plugs. The instruments are two voltmeters (500 and 250 volts), and two feeder ammeters (450 amperes); space is left for four more feeders, and two more dynamos. There is also a vertical bar for the balancer at the back of the board.

The fourth panel is fitted with the middle wire bus bar,



Figs. 7 and 8.—Switch Details.

three single-pole switches—one between the middle of the battery and the bus bar, one in circuit with the middle wire, and one in the negative side of the balancer—shunt regu-

lator for the balancer field, and balancer starting switch. There is an ammeter (250 amperes) reading both ways, in the middle wire, and a voltmeter (250 volts). Space is left for practically as much more apparatus as is already fitted. The two remaining panels are almost identical with panels 2 and 3.

The traction switchboard consists of eight panels (two spare), of which the first is the usual Board of Trade panel, fitted with recording ammeter and voltmeter; the second the line panel, and the remainder dynamo panels. The line panel is divided into positive and negative portions; the former is fitted with two single-pole feeder switches and ammeters (550 amperes); the latter carries two bus bars, one for the dynamo terminals, the other for line connections (rail return). A main switch and ammeter (750 amperes) are also on this panel; the whole return current passes through these and through a Chamberlain & Hookham ampere-hour meter fixed beneath the gallery.

Each of the dynamo panels is fitted with ammeter (550 amperes), voltmeter (450—650 volts), "Ajax" lightning arrester, I.T.E. circuit breaker, shunt regulator, and the interlocking double-pole switches for lighting and traction already referred to.

When an additional dynamo is to be thrown on the bus bars, a differentially wound voltmeter is used, one coil of which is connected with the in-coming machine, the other with the bus bars. The dynamo field is adjusted until the voltmeter reading is zero; the main switch may then be closed without affecting the bus bar pressure.

The ammeters and voltmeters mentioned above are all of the Weston type, except the recording instruments, which are of Messrs. Elliott Bros.' manufacture. Both the switchboards were manufactured by Messrs. Veritys, Limited, at their Aston works, and erected by the British Insulated Wire Company. The comparative scarcity of fuses is a noticeable feature of the boards—a praiseworthy feature in our opinion.

The back of the board is almost as clear as the front; all the cables are laid up in racks and coloured blue or red according to their polarity, and they are coupled to bars near the bottom of the board, so that there are no straggling cables or wires to interfere with its accessibility and simplicity.

There are two smaller switchboards, also of Messrs. Veritys' make, one for the motor circuits, the other for the lamps about the works.

The public lighting is effected by 44 of Messrs. P. R. Jackson's arc lamps, run 11 in series off the 460-volt distributing mains; 33 of these lamps are carried on combination trolley poles, the remainder on special arc lamp poles. Each pole is also provided with two glow lamps, which are substituted for the arcs at midnight.

The private lighting supply is carried out by means of a three-wire network with the usual disconnecting boxes, the declared pressure of supply being 230 volts.

The whole of the mains were supplied and laid by the British Insulated Wire Company, and are of their single-core paper-insulated, lead-covered type, laid in stoneware troughs filled up with compound (See fig. 4.) There are three feeders of two single cables, 0·75, 0·5, and 0·5 square inch in cross-section respectively, the total length being 4 miles of cable. The three-wire distributors consist of about 18 miles of cable, the sections of the outers chiefly used being 0·2, 0·15, and 0·1 square inch.

The Corporation shows great energy in popularising the electricity supply; motors are let out on hire, as well as cooking and heating apparatus, while service connections are made free of charge. A small rent is charged for meters. An agreement has been entered into with Messrs. F. W. Smith & Co., of Southport and Manchester, for carrying out free wiring on two systems:—

(1) Wiring absolutely free; rent of $\frac{3}{4}$d. per Board of Trade unit (reduced to $\frac{1}{2}$d. after the consumption reaches 12 units per 8 c.p. lamp per annum); purchase after three years if desired by consumer.

(2) Ten per cent. of cost paid down, the rest spread over four or five years.

Mr. Highfield has also drawn up a standard specification for house wiring which is at the disposal of intending consumers; the Corporation invites tenders and assigns the contract on behalf of the consumer, receiving 5 per cent. on the cost of the installation to cover expenses. This system has become most popular; no less than 2,000 lamps have been connected since April last by this method. It has been decided to use the old alternating plant for supplying Sutton and other outlying districts, and to supply all the lamps in St. Helens on the direct current system from the combined works at Boundary Road. The dayload of the districts supplied with alternating current will also be carried by the above works; for this purpose a motor-alternator will be put down at the alternating current station, and will be connected with the direct current works by a feeder.

The tramway belongs to the Corporation, which is responsible for its maintenance in good running order, and which provides all the plant and material required for its equipment; the actual conduct of the traffic is leased to the new St. Helens and District Tramways Company, Limited, for a term of 21 years; the company provides the rolling stock and pays a rent for the lines, which increases from £2,400 per annum at the start to £3,500 per annum in the last four years of the lease. The Corporation supplies electrical energy to the tramway company at a charge of 2d. per unit for the first 400,000 units, with a sliding scale by which the charge is reduced to 1d. per unit when the supply reaches 800,000 units per annum.

The total length of line at present equipped is about 7 miles, but an extension of 12 miles is about to be undertaken, and is to be completed within one year—which will be a very busy twelvemonth for the engineers!

The route of the line is from Prescot through St. Helens to Haydock, and from St. Helens to Salton, Denton's Green and Rainhill. There is a stiff gradient at Cropper's Hill which the steam cars could only ascend with a running start, but the electric cars ascend the slope, fully loaded, without difficulty.

The streets in the town are for the most part old and narrow, but a large part of the line lies in the open country and interurban districts.

The track was laid by the Corporation on a concrete foundation, with steel rails made by the Leeds Steel Works Company, Limited, and weighing 100 lbs. per yard. The intermediate pavement consists of granite setts. The crucible cast-steel points and crossings, steel tie bars, &c., were made by Messrs. Askham Brothers & Wilson, Limited, who also carried out a large quantity of special work at the car depôt. At a bridge over the canal special cast-steel rails were employed, as the depth available was insufficient for the ordinary rails. The points are of Marshall's patent automatic type. The rail joints are bonded with two Crown bonds under the fish plates, each bond having a cross-section equal to No. 0000 B. and S.

The poles and bracket arms are of lap-welded steel, neatly designed and manufactured by Messrs. John Spencer, Wednesbury. The overhead work consists chiefly of side bracket construction, but at some parts of the line, where the road is very broad, span wires are employed; some of the bracket arms are as much as 16 feet in length.

The whole of the overhead construction was carried out by the British Insulated Wire Company, Limited, Prescot, under the general supervision, and to the plans, of Mr. Highfield. The line material was manufactured by the Electric Tramways Equipment Company, Birmingham, with "Verus" insulation.

There is a battery sub-station on the Prescot road, about three miles from the works. The battery consists of 250 cells of the Chloride type, with an output of 150 amperes for one hour; a booster, made by the General Electric Company, Manchester, is placed in the same station, with an output of 40 amperes at 150 volts, or 80 amperes at 75 volts, at a maximum speed of 1,040 r.p.m. The field magnet is excited from the 500-volt mains, and the pressure is regulated by hand.

Thanks to the efficient bonding and to the battery sub-station, the drop in the rails is well within the Board of Trade limit, even when a number of cars are bunched at the end of the line.

The trolley wire is double throughout, 0·325 inch diameter, and is divided into sections about half a mile in length, by Aetna section insulators; it is supplied by feeders which are led into switch-pillars of the Blackwell type, one to each section. The following feeders have been laid:—Two trolley wire feeders 0·75 and 0·5 square inch cross-section; and an overhead feeder 0·4 inch diameter to the sub-station. The telephone and pilot wires are of bare copper, carried on insulators on the top of the trolley poles.

All these cables were made and laid by the British Insulated Wire Company, and are of their usual type, laid on their patent "solid" system.

There are at present eight cars in use, but the number will shortly be increased. The car bodies were made by the Brush Electrical Engineering Company, Limited, and are of the double-deck type (fig. 3), capable of seating 53 passengers. Peckham trucks are used, with a wheel-base of 6 feet gauge, 4 feet 8½ inches; each truck is equipped with two G.E. 52 motors. The car complete weighs about 7 tons unloaded. The trolleys are of the straight under-running type, with detachable heads, and were made by Messrs. Blackwell & Co. The controllers are the General Electric Company's K 10 pattern, with emergency stop. The whole of the above machinery and equipment was supplied by the British Insulated Wire Company, and erected under the supervision of their engineers.

The refuse destructor installation, which constitutes an important part of the scheme, is being carried out by Messrs. Beaman & Deas, Limited, Westminster. The installation consists of two pairs of Beaman & Deas destructor cells, each pair having a combustion chamber common to both cells. Each pair of cells is provided with one large Babcock & Wilcox water-tube boiler; and in order to utilise to the fullest possible extent the heat value of the gases from the destructor cells, a Green's economiser is also being provided. In accordance with the designers' usual practice, the cells will be worked by forced draught produced by a high pressure fan, which at the same time draws off the foul air from the pail sheds.

A special feature in connection with this installation will be the arrangements that are being made to elevate the refuse to the charging platform. Owing to the peculiarities of the site, it was found to be impossible to arrange for the usual inclined approach; specially designed bucket elevators are therefore being supplied, one set to each pair of cells, by which the refuse will be raised to the necessary height and delivered into a storage hopper opening immediately above the charging doors of the cells. The elevators and the fan for forced draught will be driven by two 12-H P. motors; the scrapers of the economisers will also be driven by a small motor. Whilst only two pairs of cells and two boilers are at present installed, all arrangements are made for the addition of a third set at any time. The two pairs are more than sufficient for present needs, if worked continuously; the provision for the third set is made not merely in view of the natural development of the town, but also in order that, if desired, the destruction of the refuse may be concentrated in less than a 24 hours' day, with a view to utilising the power available more completely.

In conclusion, we wish to record our indebtedness to Mr. J. S. Highfield, electrical engineer to the Corporation, for his invaluable assistance in preparing this account; and to Mr. E. M. Hollingworth, chief assistant engineer, who furnished us with several excellent photographs, from which we have selected views of the car and feeder trench, and of the cooling tower. We have also to express our thanks to the various contractors who forwarded to us particulars of their work.

CONTRACTS OPEN.

(*Continued from page* 104.)

Hastings.—July 25th. The Corporation wants tenders for the supplying and laying of high and low tension cables. See "Official Notices" July 14th.

Madrid.—The Ministerio de Marina is inviting tenders until 31st inst. for an electric light installation for the floating naval school.

Malmo.—September 1st. The Gas Works' directors want tenders for the erection of electricity works for the city. Particulars on application to the clerk of the Gas Works (deposit 12s).

Salford.—August 8th. The Corporation wants tenders for eight 750-kw. continuous current steam dynamos for electric lighting and traction. See "Official Notices" July 7th.

Sunderland.—July 24th. The Corporation wants tenders for the reconstruction and electrical equipment of the tramways: (*a*) permanent way, (*b*) overhead construction, (*c*) car bodies and trucks. See "Official Notices" July 7th.

Sunderland.—July 28th. The Corporation wants tenders for the supply of five Lancashire or Galloway boilers and two fuel economisers. See "Official Notices" this week.

The War Office.—The Secretary of State for War announces that tenders for various articles, including electrical instruments, will probably be invited from time to time during the next 12 months. Manufacturers who may wish to be applied to when tenders are required, should address Mr. A. Major, Director of Army Contracts, War Office, stating the particular articles they manufacture, and the names of at least two well-known firms or public bodies who have purchased from them, and are in a position to certify as to the quality of their productions.

CLOSED.

Chatham.—The Corporation has accepted the tender of the Edison & Swan Company, Limited, for the fitting up of the town hall and offices with electricity.

Crewe.—The Council has accepted the following tenders:—Mr. J. Matthews, Nantwich, chimney stack, engine house and front of boilers, £6,085 17s; Messrs. Mather & Platt, Limited, Manchester, engines and dynamos, £5,130; Messrs. Yates & Thom, Blackburn, boilers, £3,230; W. T. Henley's Telegraph Works Company, Limited, London, for conductors, &c., £6,921 12s. 7d.; and other tenders of smaller amounts.

Hackney.—The Vestry has accepted the tender sent in by the British Insulated Wire Company, Limited, for electric cables, trenching, troughing, joint boxes, and jointing and house services, for the sum of £60,000.

NOTES.

Lord Kelvin's Resignation.—At a meeting of the Glasgow University Court held on July 13th, Principal Story presiding, a petition for leave to retire from the Chair of Natural Philosophy was presented from Lord Kelvin. The Court granted the leave asked, and accepted Lord Kelvin's resignation with deep regret. A remit was made to the Principal to prepare a minute to be signed by all the members of the Court, expressing their sense of the great loss that the University is now to sustain. Lord Kelvin has occupied the chair for 53 years. We hear that Lord Kelvin has joined the board of directors of the British Aluminium Company, Limited.

Obituary.—F. C. Webb.—On Wednesday Dr. G. D. Thomas, Coroner for Central London, held an inquiry at Hampstead into the circumstances attending the death of Mr. Fredk. Chas. Webb, aged 70 years, lately residing at Agincourt Road, Hampstead, who fell, or threw himself from a second-floor window at the Hampstead Home Hospital on Saturday evening last. He entered the hospital at the end of last month for the purpose of undergoing an operation which was successfully performed, and he seemed to be progressing favourably. He, however, took a very desponding and exaggerated view of his condition, and became much depressed in consequence. He was the author of various scientific papers, and from 1853 till 1877, Mr. Webb took a leading part in all things connected with cable making, laying and testing. He was made a knight officer of the Imperial Order of the Rose by the late Emperor of Brazil in 1874. Mr. Webb had for many years practically retired from his profession, but his early labours in connection with submarine telegraphy are too well known to need recapitulation here. In 1884 he was enrolled by the Council of the Institution of Civil Engineers as a life member in consideration of the services rendered by him to the Institution. To his brother, Mr. F. H. Webb, the genial ex-secretary of the Institution of Electrical Engineers, and to his other relatives, we offer our sincere sympathy.

We regret to hear from Mr. Lord, of Messrs. Lord and Shand, electrical engineers, Plymouth, that his partner, Mr. E. B. Shand, died of heart disease, on 18th inst., at the age of 28 years.

Marriage.—On July 6th, at Hoar Cross, Mr. S. A. Walker and Miss A. M. Mosedale. The bridegroom is one of the firm of Walker Bros., electrical engineers, Old Square, Birmingham, while the bride is the second daughter of the late W. Mosedale, of Lower Hoar Cross.

Electric Tramway and Lighting Stations.—At a May meeting of the Electrical Association of New South Wales, Mr. P. B. Elwell, M.I.E.E., M.I.C.E., read a paper on "The Utilisation of Electric Energy from an Intermittent Source":—

The paper particularly dealt with the practicability of utilising the surplus power obtained from the working of electric tramways for lighting and other purposes. This question had been prominently brought forward in connection with a huge power station now in course of erection in New York, primarily to supply energy for the tramways. It was contended that, in round numbers, 66 per cent. of energy of the generating plant was available for other purposes. On all tramways the plant is taxed to its utmost at certain hours every day. In order to equalise matters and obviate the wear and tear incident to the slowing down or stoppage of the machinery, the New York Company determined to enter another field—that of supplying light, heat, and power. It was recognised by the company that with crowds of people to carry on the trams at one time of the day and none at the rest it would not pay to attempt to fill all requirements, unless the surplus power could be disposed of. They therefore arranged to establish 21 sub-stations in various parts of the city, from which light, heat, and power will be supplied for commercial purposes. This sale of the by-products of electric stations was expected to result in a reduction of 50 per cent. in the prices to be charged to the consumers. The example of New York in this matter was urged by Mr. Elwell as one to be seriously considered in connection with the electric tramlines in Sydney. It would be easy to select good positions in close proximity to the tramline for sub-stations to distribute electricity in the immediate neighbourhood. As the tramway feeders were calculated to carry the maximum load without excessive loss, and generally at a low current density, it followed that these feeders might well be used for the supply of the surplus electricity to sub-stations. This would give a quantity of electrical energy equal to that actually used for the operation of the tramway, available for supply to sub-stations in the best business centres, without any additional capital outlay, either at the power station or in feeders. The most economical size of sub-stations, and their equipment, were exhaustively considered. Storage batteries would have to be used, and as the potential on the tramway varied about 10 per cent. in ordinary operation, and one side was earthed, it followed that if the energy were to be mainly used for lighting, some method of transformation and regulation must be adopted. This could be done either by charging batteries alternately, cutting them off the discharge circuit for the purpose, or by means of a rotatory transformer between the tramway feeders and the batteries, together with an automatic regulator for the discharge. The capital cost of a typical sub-station furnished with three batteries, would be about £14,000, and the annual cost of maintenance £2,200. The best method of supplying the power from the sub-station to the purchaser would be to measure the electricity as delivered from the batteries to his sub-station bus bars. It had been found that on the average electric lighting undertakings in the United Kingdom some £70 per kilowatt was expended in distribution. If only one quarter of that sum could be saved by the sub-station system, the entire capital cost of the sub-stations with the storage batteries would be more than covered, and the cost per unit very materially reduced. A general discussion followed.

Correction.—We regret that, through an unfortunate misapprehension, in our account of the Oldham and Ashton tramways last week, we ascribed the electric brake to the Westinghouse Company. The brake actually in use is of the Thomson-Houston magnetic type, of which 16 more are to be supplied by the British Thomson-Houston Company to the tramway company, as well as eight complete cars. Five of the latter will have K 10 controllers with emergency stops, while the remaining three are to be equipped with magnetic brakes, and are to be delivered within three weeks.

Automobiles at the B.A. Meeting—A show of automobiles is to be held at Dover between September 18th and 21st next, simultaneously with a meeting of the British Association then taking place there. The meeting at Dover will be especially noteworthy, as it is held in conjunction with that of the French Society taking place at Boulogne, and an interchange of visits is already arranged for. The object of the show is primarily to provide an interesting display and to benefit the motor car industry. A small charge for space will be made, and prizes will be awarded to successful exhibitors. Full particulars may be obtained from the secretary, F. E. Beeton, Esq., Park Street, Dover.

Cricket.—Johnson & Phillips' Cables C.C. *v.* The D.P. Battery Company. This match was played on Saturday last at Blackheath, and resulted in a win for the former by 109 to 27.

Lord Kelvin's Successor.—There will be keen competition for the Chair of Natural Philosophy at Glasgow University, rendered vacant by the retirement of Lord Kelvin. According to the *Westminster Gazette*, canvassing on behalf of candidates has already begun. The salary of the post is £1,000 a year, with a large and beautiful house adjoining the University, fitted with all modern telephonic and other electrical conveniences by its late distinguished occupant. Lord Kelvin will reside at Netherhall, Largs, his beautiful country seat.

Appointments Vacant.—The Bradford Corporation wants a departmental electrical engineer. See "Official Notices" this week.

The City and Guilds of London Institute wants three assistants in the electrical engineering department of the Central Technical College. See "Official Notices" this week.

The Salford Corporation wants a first-class cable jointer. See "Official Notices" this week.

The Corporation of Bootle require the services of an electrical engineer.

The Electrical Engineers R.E. Volunteers.—The first detachment of this corps has finished its annual training at Plymouth. It has put in some interesting work in connection with projectors for search lighting and running plant to supply same, and some very useful work was done in submarine mine work. The next detachment will go to Portsmouth for eight days commencing July 29th, and may possibly take part in the Naval Manœuvres.

Personal.—Mr. H. E. Yerbery, A.I.E.E., late assistant electrical engineer of the Bristol Tramways, has been appointed assistant electrical engineer on the Sheffield Corporation Tramways.

Mr. C. A. L. Prussmann, chief assistant electrical engineer for the Bradford Corporation, has been appointed clerk of works at the Doncaster electricity works.

The Institution of Junior Engineers.—On Thursday next, July 27th, at 3 p.m., the Institution will visit Messrs. Edw. Cook & Co.'s East London Soap Works, Bow.

Lightning at Play.—Electra—not the Chancery Lane goddess—has been playing strange pranks in Newcastle. We hear that "a thunderbolt—a brigh. ball of fire" was seen to fall, and in one case a flash of lightning "entered through the window, and the electricity played about the wires attached to a telephone on the table, eventually disappearing in a corner." We are persuaded that this must be the corner in copper of which we have heard rumours.

Manchester Moving.—Our leader of this week refers to an important development in the electrical industry, and we hear rumours of yet another. It is said that a big combine is in progress to be launched in a very few weeks, the names mentioned being those of Messrs. P. R. Jackson and Co., of Salford, and the Ganz Company. Manchester is also credited with still further developments on the part of a powerful company not a hundred miles from Salford.

NEW COMPANIES REGISTERED.

Anglo-Spanish Electricity Company, Limited (62,655).—This company was registered on June 21st, with a capital of £100 in £1 shares, to carry on the business of electricians, suppliers of electricity, &c. The first subscribers (each with one share) are:—A. Lucas, Melbourne, Brampton Road, Bexley Heath, clerk; H. F. Wreford, 47, Nicholl Road, Harlesden, Middlesex, incorporated accountant; C. F. A. Spashett, Lansdowne, Hillfield Road, West Hampstead, N.W., registrar; J. H. McCashin, 73, Webb's Road, Clapham Junction, S.W., clerk; H. P. Hetherington, 17, Powis Square, W., clerk; W. H. Ostertag, 38, Church Road, Richmond, clerk; and J. A. Marrot, 30, South Eaton Place, S.W., gentleman. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first; no qualification; remuneration, £1,000 per annum divisible.

Sharpe & Co., Limited (62,699).—This company was registered on June 23rd, with a capital of £2,500 in £1 shares, to acquire and carry on the business of sanitary, gas, hot water, electrical and general engineers, smiths, &c., now carried on by Sharpe and Co., at 22, 24, and 26, Strand Street, Grimsby, Lincolnshire, and to enter into an agreement with the said vendors. The first subscribers (each with one share) are:—John H King, 163, Freeman Street, Grimsby, foreman plumber; William Cooper, 114, Welholme Road, Grimsby, foreman; T. Bell, Redshaw, 33, Tarburg Street, Grimsby, plumber; William C. Sharpe, George Street, Louth, Lincolnshire, sanitary engineer; John C. Store, Cedar House, Abbey Park Road, Grimsby, accountant; Anne E. Sharpe, Belvoir, Grantham; and Ada Sharpe, 12, George Street, Louth. The number of directors, the names of the first, and their remuneration, are to be determined by the company. Registered office, 26, Strand Street, Great Grimsby.

Llanrwst Electricity Supply Company, Limited (62,720).—This company was registered on June 26th, with a capital of £5,000 in £1 shares, to acquire and carry on the business of electrical and mechanical engineers and suppliers of electricity for the purposes of light and power now carried on at Llanrwst, Denbigh, by G. F. McInnes and G. R. Peers as "The Llanrwst Electricity Supply Company." The first subscribers (each with one share) are:—C. F. McInnes, Carrington Terrace, Llanrwst, electrical engineer; J. E. Humphreys, Llanrwst, solicitor; J. E. Jones, furniture warehouse, Llanrwst, general dealer; Mrs. A. McInnes, 4, Carrington Terrace, Llanrwst; J. O. Thomas, 14, Watling Street, Llanrwst, accountant; Mrs. G. S. L. Thomas, 14, Watling Street, Llanrwst; and J. W. Owen, Llysmedyg, Llanrwst, surgeon. Registered without articles of association. Registered office, 14, Watling Street, Llanrwst, Denbigh.

Theatroscope Syndicate, Limited (62,764).—This company was registered on June 28th, with a capital of £25,000 in £1 shares, to acquire, own, and work the British, Colonial, and French rights in respect of an invention for projecting on to screens animated scenes in colours, to enter into an agreement with the Société Internationale d'Etudes Industrielles, and to carry on business as electricians, caterers for public entertainments, &c. The subscribers (each with one share) are:—H. E Taylor, 28, Finsbury Pavement, E.C., mining engineer; A. Clippingdale, 17, Honley Road, Catford, S.E., gentleman; W. H. Taylor, 78, Allison Road, Harringay, N., engineer; H. W. Green, Stock Exchange, E.C., gentleman; W. G. Blakeman, 57, Moorgate Street, E.C., chartered accountant; W. H. Chantry, 57, Moorgate Street., E.C., chartered accountant; W. D. Clippingdale, 17, Honley Road, Catford, S.E., engineer. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first; remuneration, 10 per cent. of the net profits divided between them. Registered office, 28, Finsbury Pavement, E.C.

Woodhouse and Baillie Riviera Electricity Company, Limited (62,791).—This company was registered on June 29th, with a capital of £50,000 in £1 shares (16,000 first preference and 20,000 second preference), to enter into an agreement with C. H. E. Woodhouse and G. H. Baillie, and to carry on the business of electricians, mechanical, electrical and general engineers, suppliers of electricity and other agencies for the purposes of light, power and otherwise, manufacturers of and dealers in electrical machinery and apparatus, &c. The first subscribers (each with one second preference share) are:—Claude H. C. Woodhouse, 7, Charlwood Road, Putney, S.W., electrical engineer; Ernest W. Shevens, 59, Cressingham Road, Lewisham, Kent, clerk; William H. Milne, 70, Forthbridge Road, Clapham, S.W., clerk; William T. Parkes, White House, Elstree, Herts, clerk; Francis J. Pepper, The Elms, Willesden Green, N.W., clerk; George Forrest, 28-9, Chancery Lane, W.C., accountant; and John A. Parkes, 93-4, Chancery Lane, W.C., solicitor. The number of directors is not to be less than three nor more than seven; the first are Claude H. C. Woodhouse, Glanville H. Baillie, and Arthur M. Hanbury; qualification, £500; remuneration as fixed by the company. Registered office, 28, Queen Street, E.C.

Tayside Electric and Gas Light Company, Limited (4,308).—This company was registered at Edinburgh on June 24th, with a capital of £25,000 in £1 shares, to acquire the business of the Newport Gas Company, and to carry on the business of manufacturers and suppliers of gas and electricity, for heat, light, or power. The first subscribers (each with one share) are:—Walter Corbet, Acton Regnald, Shrewsbury, land proprietor; Henry Wedderburn, Berkhill Cupar, Fife, land proprietor; Andrew Leitch, Netherlea, Newport, Fife, shipowner; James Lowson, Kilnburn, Newport, Fife, retired merchant; James Orr, Newport, Fife, land agent; Thomas Winton, Newport, Fife, wood merchant; and Alexander Stewart, Wormit, Fife, builder. The number of directors is not to be less than five nor more than nine; the subscribers are to appoint the first; qualification, 100 shares; remuneration as fixed by the company. Registered office, 9, Ward Road, Dundee.

Telepantograph Syndicate, Limited (62,843).—This company was registered on July 3rd, with a capital of £10,000 in £10 shares, to enter into an agreement with R. Greville-Williams and to carry on any business directly or indirectly connected with the supply and employment of electricity, and in particular to establish and maintain a system of telepantographic exchanges and telepantographic communication. The first subscribers (each with one share) are:—George Kemp, 71, Portland Place, W., M.P.; E. Tootal Broadhurst, 56, Oxford Street, Manchester, manufacturer; Rupert Greville-Williams, Simpson Hill House, Heywood, chemist and electrician; W. H. A. Gaddum, 7, South Street, Manchester, merchant; James G. Groves, Regent Road, Bravery, Salford, brewer; C. H. Scott, Ackers Street, Manchester, merchant; and C. Tattersall, Oakdale, Altrincham, merchant. The first directors (to number not less than three nor more than seven) are to be nominated by the subscribers; qualification, £500; remuneration as the company may decide.

CITY NOTES.

The Elmore Amalgamations.

Extraordinary meetings of the four Elmore companies were held on Monday last at the Cannon Street Hotel for the purpose of confirming the resolutions passed on June 29th for the voluntary winding up of the concerns and the appointment of Mr. James Shurmer, of Hunslet, Leeds, as the liquidator for the purposes of such winding up. Mr. A. S. Elmore presided over the meeting of Elmore's Patent Copper Depositing Company, Limited, Mr. F. Elmore over that of Elmore's Wire Manufacturing Company, Limited, Mr. J. T. Cooper over that of Elmore's American and Canadian Patent Copper Depositing Company, Limited, and Mr. F. L. Rawson was the chairman at the Elmore's Foreign and Colonial Patent Copper Depositing Company, Limited. In the case of the first three companies the resolutions were formally moved and carried without any discussion, but considerable discussion ensued with regard to the resolution affecting the last-named company—the Elmore's Foreign and Colonial Patent Copper Depositing Company, Limited.

The Chairman (Mr. Rawson), in moving the confirmation of the resolution, which was in these terms:—"That the company be wound up voluntarily, subject to the company receiving £48,000 in fully paid-up shares in Elmore's Trust, Limited, or such lesser number as the committee appointed at this meeting may consider fit, and failing agreement the question of the amount is to be submitted to arbitration"—said that at the last meeting it was left to a committee which was then appointed, to settle whether they would accept the 33,000 shares that were offered or go to arbitration, or whether any other amount should be accepted. Ultimately the committee agreed that the foreign company should receive 45,000 fully-paid shares in the Trust Company, so settling the questions in dispute between the Foreign Elmore Company and those who were specially interested in the formation of the new company. The second matter that was left for the committee to consider was as to the division of the 45,000 shares among the shareholders. According to the articles of association, each founder's share would be entitled to the same amount as each priority share received. By the articles each priority share was entitled to receive back by dividend and bonus 100 per cent. out of the profits before the founders' shares received anything. The priority shares had received back £5 each—that was to say, the full amount of their shares, and those holding priority shares argued that they were entitled to receive another £5 before the founders' shares received anything, but that contention was not strictly accurate, because they were to receive their money out of profits. In order to enable them to receive anything, it would have been necessary to show that the capital of the company, consisting of 15,000 priority shares of £5 each and 9,000 founders' shares of £5 each, was intact. It was impossible to show that, and therefore it was a very great question whether the priority shares would have been entitled to receive anything at all, even if the company had remained in existence. The argument of the founders was that they had never received one penny; that the priority shares had received £5 each, and that therefore, in the distribution they were entitled to something more than the priority shareholders. A good many of the priority shareholders argued that they had bought their shares at £10 and £11, and that it was not they who had received a bonus of £5, but their predecessors, and that consequently the founders' shares were not entitled to anything more than they were. The founders' shareholder's reply to that was that some of them had paid £19 each for their shares. A committee was appointed consisting of Mr. Busch, Mr. Foster and Mr. Freeman, representing the priority shareholders, and Mr. Holmes, Mr. A. S. Elmore and Mr. Hewitt represented the holders of founders' shares, and Mr. Bennett, who held both classes of shares was added to the committee, so that in the event of a division of opinion arising he should practically settle what should be done. The result of that meeting was that Mr. Busch practically led the opposition on behalf of the priority shareholders, and he was very strongly of opinion that they should have had something extra given to them, and ultimately it remained with Mr. Bennett to say what the distribution should be. That gentleman came to the opinion that in the best interests of the company the division of the shares should remain exactly as the legal position left it—that was to say, that each founder's share should receive the same amount as each priority share. He (Mr. Rawson) thought that the committee who had acted now for nearly two years in assisting the board to arrive at a settlement with those who had been interested in forming the new company, should receive some small remuneration for their services. That had not been asked for, and, in fact, some of the committee had said that they did not think they were entitled to anything, as they had given their time freely. He, however, thought that that was a mistaken view, and even if it was only a small amount, he believed in giving the committee something for the hard work they had done for the shareholders. Taking the view that 48,000 shares was the proper amount to be received, he did not

believe they would have been able to have got the 45,000 which had now been settled on, had it not been for the work of the committee in insisting upon a fair proportion of the assets coming to the foreign company.

Mr. Shurmer seconded the resolution.

Major Phillips expressed himself dissatisfied with the way in which it was proposed to distribute the 45,000 shares. In his opinion, the founders' shares ought not to receive anything at all and the priority shares ought to receive the full amount, and unless some more equitable form of distribution could be arranged he should feel bound to vote against the resolution.

The Chairman said there might be something in Major Phillips's contention if the vendors held a very large amount of the founders' shares. At the present time not more than 1,500 out of the lot were held by the vendors, and they also held a considerable number of priority shares which they had bought.

Mr. G. H. Busch (chairman of the committee) said they had been informed by the directors that the committee had succeeded in increasing the selling price of their assets to the Elmore Trust to £45,000 in shares from the £33,000 originally offered. They did not think it worth while to go to arbitration for the sake of insisting upon the extra £3,000, as the difference would be so very small to each individual shareholder. As to the division of the £45,000 among the founders and priority shareholders, the decision was come to that they should be divided *pro rata*, giving each shareholder £1 17s. 6d. for every old share he held, be it priority or founders. Personally, he held that the priority shareholders ought to have had the preferences, and he fought hard to obtain £31,500 for the priority shareholders and £13,500 for the founders. Mr. Bennett, however, advocated the division *pro rata*, and some other members of the committee unable to attend intimated to Mr. Rawson before the meeting that they should be satisfied with that arrangement. They understood, too, from the chairman, that another large priority shareholder had expressed his consent. What made him (Mr. Busch) finally give way was that the articles of association having, strangely enough, not provided for any preference as to capital for the priority shares, the legal aspect would, in all probability, be in favour of a division *pro rata*. Therefore, even if his suggestion had been carried, some of the founder shareholders might have gone to law about the matter, and thereby created delay and expense. The only other point the committee had to decide on was with reference to the liquidator, and they had decided to recommend that Mr. Cartwright should be appointed instead of Mr. Shurmer. In conclusion, Mr. Busch said he hoped that the new undertaking would meet with every success.

Mr. Ellis said he was of opinion that the committee ought not to have decided as to the way the 45,000 shares should be distributed, and he thought they had rather gone beyond their power in making the arrangement.

In reply to Major Phillips, the Chairman said he was not aware whether the vendors were willing to forego the founders' shares which they still held.

Mr. Paitchard said that, as an original holder both of founders' and priority shares, he considered that the division was a very fair one.

After some discussion the resolution was carried.

The Chairman then proposed Mr. Shurmer as the liquidator, remarking that that gentleman was willing to act free of all expense.

Mr. Cooper seconded.

Mr. Ellis said he thought it was agreed at the last meeting that they should have an independent liquidator, and he would certainly prefer to see Mr. Cartwright, for he knew all about the Elmore Companies, and was thoroughly honest and able in every respect.

Mr. Busch said that although they had no personal feeling against Mr. Shurmer, as the general meeting wanted an independent liquidator, he thought the directors ought to yield.

After some discussion, Mr. Shurmer's appointment was carried by nine votes to five.

On the motion of the Chairman, it was agreed to vote the committee 50 guineas for their work. A vote of thanks to the chairman for presiding terminated the proceedings.

Electric Construction Company, Limited.

Sir Daniel Cooper presided on July 13th, at Winchester House, at the sixth annual general meeting of the shareholders of the above-named company.

The Chairman, in moving the adoption of the report, pointed out that the gross manufacturing profits for the year ended May 31st last amounted to £48,544, showing an increase of £2,698 over those of last year, and including the balance brought forward there was now £21,393 of profits to appropriate. Of this sum the board proposed to apply £16,952 in paying the dividend of 7 per cent. on the preferred and a dividend of 6 per cent. on the ordinary shares, and to add £3,000 to the general reserve fund, making the amount at the credit of this account £20,000. The reserve fund was intended to meet any exceptional loss, which, in spite of careful management, would sometimes arise, and also to provide for any unexpected loss in realising the company's securities. He did not look for any call on this fund, which strengthened the position of the company, and gave confidence in its future. The business of the company and the out-turn of their factories continued to make satisfactory progress, and the excellence of their manufactures had been fully maintained. During the year they had, besides largely increasing the output of standard machines, successfully installed some of the largest dynamos of their kind in this country. The electric equipment of the City and South London Railway extension on which they were now engaged would, they hoped, demonstrate that their company were at least as well qualified as their American rivals to provide such installations. It must, however, be confessed that some cause for disappointment had been given to a few of the company's customers by some unavoidable delay in executing their orders, caused, partly by novelty in the designs, and partly by pressure of work. To prevent the latter, a considerable addition was being made to their workshops, and larger tools and appliances were being provided to cope more advantageously with the large machines now coming generally into use. The board had not been eager to enlarge the works, but the growth of the business and the prospects of great development in the use of electrical power had satisfied them of the expediency of this step. Besides enabling the company to execute orders promptly, these additions would tend to economy in cost of production, as their fixed standing charges would be spread over a larger output. The directors expected that the extensions would be completed and in full working order before another year had elapsed, and the company's factories would then be the largest and the best equipped, especially for the construction of large machines, of any in this country. Some additional capital might then be necessary, but the board would, perhaps, be able to arrange for it without any further issue of shares. The shareholders would probably recollect that at the last general meeting he mentioned that the directors contemplated making an offer to them of part of the company's holding in shares of the Electrical Power Storage Company, Limited. The proposal was submitted to them in last October, and nearly half of the shares offered were applied for and allotted to shareholders. The board might again submit the unallotted balance, and if these shares were taken up, it might be unnecessary to issue any more of the company's own shares, or, if so, only to a very limited extent. All their first and second 6 per cent. debentures had been converted into 4 per cent. debenture stock, and a large portion of floating debt into redeemable 4½ per cent. second debenture stock. The whole expense of this conversion had been written off, and in addition to the important reduction of interest already experienced, there would be a further saving in the coming year. The compensation for injuries paid to workmen during the year had not exceeded £20, although the company were none more liberal in their treatment of those who had suffered than was provided by the Act. Their relations with their employés were also thoroughly harmonious. The men had for some years been paid an annual bonus on their wages, and the board intended that this bonus should bear a fixed proportion to the dividend paid on the ordinary shares. It was thus to the men's pecuniary advantage to co-operate heartily in working for the success of the business. The shareholders would, he felt sure, agree that this was a sound and an enlightened policy in the management of such works as the company's, and he believed that it was bearing fruit in a steady growth of confidence on both sides, and of cordial co-operation among all the company's employés. During the present management the position of the company had been strengthened every year both within and without. There was before them an enormous development in the use of electric power, involving, of course, a corresponding demand for the company's manufactures. With the extensions they would have factories capable of increasing largely the output of their standard manufactures as well as of producing the largest machines that could practically be required, and they were steadily building up a business that would, he hoped, not only prove profitable, but also permanent and a credit to everyone concerned.

Mr. James Wm. Barclay (deputy chairman) seconded the motion, and it was carried unanimously.

The retiring directors, Sir H. C. Mance and Mr. P. E. Beachcroft, and the auditors, Messrs. James Merton & Co., were re-elected, and the proceedings terminated with a vote of thanks to the chairman.

Electrical Power Storage Company, Limited.

The tenth ordinary general meeting was held on July 13th at the offices, Great Winchester Street.

Mr. J. Irving Courtenay, who presided, stated that after paying debenture interest and adding a substantial amount to the contingent fund, a net profit of £4,532 remained, which, with the sum brought forward, made a total of £4,889 available for distribution. The directors, therefore, recommended a similar dividend to that which had been paid for the last six years—namely, 5 per cent.—leaving £554 to be carried forward. To meet the demand for E.P.S. storage batteries, which had during the past year very considerably increased, new buildings had been erected at a cost of about £1,500, while over £1,600 had been expended in providing plant. Their work came near to what was designated a dangerous trade, and the board had therefore to comply with the wishes of the Home Office in the matter of precautions for the health of the workmen. The result of the year's work might be deemed satisfactory, as not only had severe competition to be faced, but prices of all raw material, and especially of lead, had shown a considerable upward tendency. The directors were obliged to increase their prices 10 per cent., but little of the accruing benefit came into the past financial year. In order to compete for some contracts it was necessary to enter into agreements for the upkeep of the battery for periods varying from five to 15 years. This was, he thought, prejudicial to the industry generally, besides fostering unfair competition, as it enabled certain persons, by offering a low maintenance rate, to secure contracts. When the time came for the maintenance contracts to be carried out and renewals made, the customer frequently found that the guarantors had in the meantime ceased to exist. The policy of their company had always been to enter into maintenance contracts at rates which might reasonably be expected to cover the risks. The directors had started, in addition to the reserve fund, a special contingent fund, for the purpose of making further provision against this class of liability. Such a reserve added greatly to the strength of the com-

pany, and he could not help thinking that engineers, electric companies, and committees of local authorities generally would in time find that the only safe way to deal with contracts of this description was to satisfy themselves that the parties giving these maintenance guarantees had adequate reserves to meet the risks. Among the company's larger work completed during the past year he might specially mention that they had installed a traction battery for the Liverpool Corporation, had extended the batteries for the Birmingham Electric Supply Company, and had erected one for the Metropolitan Electric Supply Company; and, in addition, they had erected batteries at Colchester, Morecambe, Belfast, and Leith for the various lighting authorities. Among important contracts in hand might be mentioned one with the Metropolitan Electric Supply Company for their station at Willesden, and also batteries for the Gloucester, Bradford, Doncaster, and Bury St. Edmunds Corporations, and for the London County Council's works at Crossness. The contract for the supply of batteries to the London Electrical Cab Company had now been completed, and the batteries were doing well. The company had devoted a great deal of attention to the problem of constructing a battery capable of providing heavy currents for lighting and traction work in central stations, and in this respect they had been singularly successful. The board had decided that the company should take part in the Exhibition to be held next year in Paris, where they proposed to show some of the latest types of the company's manufactures, special attention being given to traction types of cells, for which the directors believed that there was a considerable market opening on the Continent. He concluded by moving a resolution for the adoption of the report and the payment of the dividend recommended.

Sir Daniel Cooper seconded the motion, which was carried unanimously.

Eastern Telegraph Company, Limited.

The report for the half-year ended March 31st, according to the *Times*, states that the revenue amounted to £493,504, from which are deducted £122,561 for ordinary expenses and £34,520 for expenditure relating to repairs and renewals of cables, &c., during the half-year. After providing £4,333 for depreciation of spare cable and £7,413 for income-tax, there remains a balance added to £35,447 brought from the preceding half-year of £360,122. An interim dividend of 1½ per cent. on the ordinary stock has been paid, the directors have placed £10,000 to reserve fund for maintenance ships, £5,050 to the reserve in connection with removal of head office, £2,000 to the reserve fund for insurance of goods in transit, and £100,000 to the general reserve fund. They now recommend a final dividend on the ordinary stock for the year of 1½ per cent. and a bonus of 2 per cent., amounting together to £133,000, both payable on the 20th inst., free of tax, and making a total distribution of 7 per cent. for the year. A balance of £3,536 is carried forward. The revenue includes £25,112 dividends for the half-year upon the company's investments in other telegraph companies. The British Government having announced that it was prepared to co-operate with the Governments of Australasia and Canada in the laying of a Government cable across the Pacific Ocean, the directors of this and the Eastern Extension Telegraph Company considered it necessary in the interests of the proprietors to protest against the British Government entering into active competition with private enterprise, and pledging the public credit of the country for such a purpose. Accordingly a deputation from the two companies waited upon the Chancellor of the Exchequer and the Secretary of State for the Colonies, in order to express the companies' very grave objections to so serious an attack upon private interests. The directors consider that should the laying of the Pacific cable be decided upon, it should be worked and maintained by private enterprise, and not by Government agency. The convention with the French Government for a landline through France to Marseilles terminated in March last, and the new cable from this country to Gibraltar, Malta, and Egypt, referred to at the last meeting, was completed on January 23rd. The direct telegraph communication with Egypt and the Far East, as well as South Africa, has thereby been materially strengthened. The cost of the Malta-Alexandria section has been charged against the general reserve fund.

West African Telegraph Company.

The directors' report for the year ended December 31st, 1898, presented to the meeting held at Winchester House, E.C., yesterday, reads as follows:—"The directors submit the accounts and balance-sheet of the company for the 12 months ended December 31st, 1898. The company's revenue for that period amounted to £65,522 15s., against which £21,526 16s. 6d., is charged for ordinary expenses, and £17,717 18s. 7d. for expenditure relating to repairs of cables, &c. After providing £522 17s. 4d. for income-tax and £175 13s. 2d. for revaluation of currency assets, there remains a balance of £25,579 9s. 5d., to which is added £372 12s. 6d. brought from the preceding year, making a total available balance of £25,952 1s. 11d. From this balance there has been deducted £9,439 10s. 1d. for interest on debentures, and £14,333 6s. 8d. for sinking fund, leaving a balance of £2,179 5s. 2d., which it is proposed to carry forward to next year. The revenue for the year under review includes a further sum of £12,000 in respect of subsidy due from the French Government, but which has not yet been paid. As will be seen from page 9 of the accounts, this arrear, together with the sums withheld in previous years, now amounts to £44,415. The director who retires by rotation is Sir Henry C. Mance, C.I.E., M.Inst.C.E., who, being eligible, offers himself for re-election. The auditors, Messrs. Deloitte, Dever, Griffiths & Co., also retire, and offer themselves for re-election."

The British Aluminium Company, Limited.

Mr. Wallace, Q.C. (chairman) presided on Tuesday at the Westminster Palace Hotel over the fourth ordinary general meeting of the shareholders of the above company, and, in moving the adoption of the report, said they had hoped to have met earlier, but they had had the question before them of raising further capital and consolidating the debentures. It had always been their endeavour to keep the preference capital and the ordinary shares at their original amount, and thus to provide new capital they had decided to increase the debentures. To do that they had had to get a fresh valuation of their capital. He had previously explained to them the various operations they carried on in their factories, and he need only tell them on the present occasion that the work was going on satisfactorily. They had reduced the cost of their product, and from experiments they had made they hoped still further to decrease it. What would interest them most was the demand for their product, and that was going on slowly but surely. Taking the supply of aluminium for the world since 1889 it had increased eight times, and with regard to the company's sales in England since 1885 it had increased six times. They would thus see that the demand was increasing, but not so rapidly as they had the right to expect. During the last six months of the year compared with the corresponding six months the sales had increased 48½ per cent., which was very good. The Government of the country had given them little assistance. They had given them trial orders, but not such orders as, in comparison with the orders given by other Governments, they had the right to expect. No doubt they would give more when the trials were complete. In Germany the army was practically equipped with aluminium utensils, and in the German ships of war almost all the internal fittings were of aluminium. Of course, there was much more done for them in the Naval Department of the country than in the War Department, but still not as much as they expected. With regard to the general trade of the country, he told them last year that they had been interfered with because of the strike, and now they were being affected because of the full state of the country's workshops. Thus the shareholders must be patient. A good deal had been said with regard to the action of sea water upon aluminium, but those reports had been very much exaggerated. He was not at liberty to say anything about the *Shamrock*, but he could say of the *Defender*, that although she had lain in dock for 4½ years, she had not deteriorated. With regard to the use of aluminium for electrical purposes, that was going on very fast in America, but not so fast in that country as they would like. Lord Kelvin had spoken highly of aluminium, and at the present price of copper, aluminium was much cheaper for transmitting electricity over telegraph and telephone wires. Experiments were being made in that direction by the Government, and being much lighter than copper it did not require so many poles. The chairman referred to the satisfactory arrangement made with the Acetylene Illuminating Company to take over the manufacture of the product at Foyers on terms beneficial to the company. In conclusion, he welcomed the co-operation of Lord Kelvin on the board.

Lord Kelvin seconded the motion, and said they did not know how far aluminum could be protected by paint, but they had great hope in that direction with respect to the building of ships. He thought there was a good future before the company.

Replying to a shareholder, the Chairman said they had only paid six months' interest on the preference shares, but they would pay the balance when they found they had sufficient money in hand to spare it. When they got their fresh debentures they would not be paying much more interest than they did now.

The report was adopted, and at a subsequent meeting alterations in the articles of association were agreed to.

The Bristol Tramways and Carriage Company.

The directors at their meeting on July 19th, declared an interim dividend to June 30th last at 7 per cent. per annum, payable on August 5th. The total receipts of the company for the half-year were £72,396 14s. 9d., against £67,246 16s. 10d., an increase of £5,149 17s. 11d. over the corresponding period last year, whilst the number of passengers carried was 11,408,683, against 10,680,379, an increase of 728,304. The interest on debenture stock and interim dividend of 7 per cent. per annum absorbs £19,489 2s. 5d., against £13,189 9s. 4d. in the corresponding period last year, when the dividend was 6 per cent. per annum.

Telegraph Construction and Maintenance Company.

The half-yearly general meeting of the shareholders of this company was held on Tuesday at the offices, 38, Old Broad Street, Sir Robt. G. W. Herbert presiding.

In proposing the adoption of the report, the Chairman said he was pleased to be able to state that the affairs of the company continued in a satisfactory condition. That being the half-yearly meeting, there were no accounts to be presented, but he was pleased to be able to tell them that their factories were in excellent working condition, and had been kept well employed throughout the six months. Their ships were in very good order, but they had not been engaged to the same extent as in the previous half-year, because the work which they had been doing had been in a great measure that of supplying various companies and governments with reserves of cables and in effecting repairs which had not required their larger ships to go to sea for any lengthened period. They had been able to provide for the payment of the usual interim dividend of 5 per cent., and they were hopeful for the future, as the works were well employed, and already some progress had been made towards completing a satisfactory dividend when the year's accounts closed.

Replying to Mr. CROFT (a shareholder) the CHAIRMAN said that the question of the proposed cable by the Azores to America was still under negotiation, and no definite conclusion had yet been arrived at. It was true that the Germans were not in a position to carry out large cable-laying enterprises without help from this country, and it was not improbable, therefore, that a stipulation might be made that wire and other materials of German make should be employed in the manufacture of a cable which their company or some other company might construct for the German Government. He did not think that would be an unreasonable arrangement, but at present he could not say anything definite on the subject.

The meeting then terminated.

The Direct United States Cable Company, Limited.

THE report of the directors for the six months ended June 30th, 1899, will be presented at the forty-fourth ordinary general meeting of the company, to be held at Winchester House (Hall No. 174) 50, Old Broad Street, in the City of London, on Tuesday, July 25th, 1899, at 2 o'clock p.m. The directors in their usual statement of accounts state that the half-year's revenue, after deducting out-payments amounted to £51,951 8s. 2d. as compared with £52,232 12s. 1d. for the corresponding period of 1898, showing a difference of £281 3s. 11d. against the half-year under review, which must be considered satisfactory, having regard to the exceptional increase in the revenue during the spring of last year owing to the Spanish-American war. The working and other expenses for the same period, including income-tax, but exclusive of cost of repairs of cables, amounted to £20,411 8s. 1d., leaving a balance of £31,540 0s. 1d. as the net profit, making with £5,920 16s. 8d. brought forward from the previous half-year a total of £37,460 16s. 9d. For the corresponding period of 1898 the working expenses and other payments amounted to £21,685 12s. 6d. Three quarterly interim dividends of 3s. each per share, amounting to £27,319 10s., have been declared and paid during the financial year, and a final dividend of 3s. per share is now proposed, together with a bonus of 2s. per share, making with the three interim dividends 3½ per cent. for the year, or a total distribution of £42,497. After transferring £10,000 to the reserve fund account, the balance of £3,176 16s. 9d. on the revenue account is proposed to be carried forward. The reserve fund account has been debited with £2,603 13s. for cost of cable repairs, and after being credited with interest, realised profit, and sum transferred from revenue account, the balance of the reserve fund, taking the investments at cost price, now amounts to £382,365 19s. 6d. Pursuant to the provisions of the articles of association two of the directors, viz., E. M. Underdown, Esq., Q.C., and Sir James Pender, Bart., M.P., retire by rotation, and, being eligible, offer themselves for re-election. Messrs. Deloitte, Dever, Griffiths & Co., and Messrs. J. & J. Sawyer and Co., the auditors, retire pursuant to the articles of association, and offer themselves for re-election.

Jandus Arc Lamp and Electric Company, Limited.

THE annual meeting was held at 46, Brown Street, Manchester, on July 11th, Mr. E. N. Galloway, chairman of the directors, presiding. The report, which was unanimously adopted, recommended a dividend of 40 per cent. for the year ended April 30th last, payable free of income-tax, and that £1,000 be written off patents account. This is the third year in succession in which the company has paid 40 per cent. The report contains a schedule of 23 companies and firms which have now recognised the "Jandus" patent and accepted licenses. The company is at present fitting up extensive new works in Holloway, London, which will enable the directors to deal with the rapidly-increasing business. Mr. Thomas A. Earle, Manchester, and Mr. Bernard Drake, London, the retiring directors, were unanimously re-elected.

City Electric Lighting.

THE City Corporation has received the following letter from the City of London Electric Lighting Company, Limited:—

"1 and 2, Great Winchester Street, London, E.C.
"Manager and Secretary's Office,
"*July 17th*, 1899.

"To the Town Clerk, Guildhall, E.C.

"Sir,—My directors had before them at their meeting to-day the correspondence which has passed recently between the respective solicitors of the Corporation and the company, from which it appears that the Streets Committee will not meet my directors to discuss the position, but have expressed themselves as being willing to consider any proposals my board may deem it desirable to submit in writing. I am instructed by my board to submit the following proposals:—

"I.—As to a reduction in the price of electricity, conditional on the Charing Cross and Strand Company's Bill being rejected, and an amending Act (as below) being passed:—

"1. The company to apply for an Act, supported by the Corporation, to relieve the company of the obligations imposed by the Act of 1893 as to depreciation and reserve funds, imposing in lieu thereof no larger obligations than are imposed on other companies who have to keep their accounts in the form required by the Board of Trade.

"2. Agree that the company may use the same plant and mains for public and private lighting.

"3. The company will, if the Corporation wish, give up the lighting of the side streets.

"4. (*a*) The Corporation not to oppose the present or future applications to the Board of Trade for continuous current;

"(*b*) and to consent to the alteration of the standard pressure to 200 volts.

"5. The company to reduce their prices to those set forth in the Charing Cross order on the passing of the amending Act above referred to.

"6. In all other respects the existing Acts and contracts to remain in force, and the contracts alleged to be null and void to be 'set up' again with above modifications.

"II.—As regards purchase—My board are prepared at the present time to negotiate for the sale of the whole of the company's undertaking to the Corporation upon the basis of the Corporation issuing to the company such an amount of Corporation stock as will produce an annual income of £75,000. I am to point out that the net revenue derivable by the Corporation from the company's undertaking should be at least £120,000, made up as follows:—

Net revenue for 1898 as per published accounts	£93,773
Interest on deposits, investments, &c.	3,406
Add savings in administration, &c., which would not fall upon the Corporation	7,000
	£106,179
Add increase of revenue for 1899, by reason of the greater number of lamps connected, estimated to be at least	14,000
	£120,179

"This calculation is made on an average charge of 6·22*d.* per unit.

"A purchase on this footing would give the Corporation an immediate profit of £45,000 per annum, which might be applied either in reduction of price to the consumer or in relief of the rates.

"The sale to the Corporation would include the entire assets of the company, subject to liabilities incurred for additional plant, &c.

"I am directed to forward a copy of this letter to each member of the Corporation.—I am, &c.,

"J. CECIL BULL, Manager and Secretary."

Prospectuses.

KIDDERMINSTER AND DISTRICT ELECTRIC LIGHTING AND TRACTION COMPANY, LIMITED.

A COMPANY has been formed, having the above title, for the purpose of acquiring all the issued shares of the Kidderminster and Stourport Electric Tramway Company (except 120 shares held by the directors), and of taking over the electric lighting order granted to the Corporation of Kidderminster. The old company was formed in 1896, with a capital of £60,000, but has not the necessary statutory powers to undertake the supply of electrical energy. The tramway is about 4½ miles long, and is electrically equipped on the overhead system; there are nine cars in regular work. The area of supply under the provisional order includes the whole of the municipal borough of Kidderminster. The tramway company pays the British Electric Traction Company £56,000 for the undertaking as it stands, as well as the costs incurred by the latter company in promoting the new company. The authorised capital is £100,000, divided into 5,000 5 per cent. cumulative preference shares and 5,000 ordinary shares of £10 each. The present issue comprises 3,000 5 per cent. cumulative preference shares. The list opened July 18th and closes to-day. The secretary is Mr. H. S. Hodgson; offices, Denington House, Norfolk Street, Strand, W.C.

THE HORSFALL DESTRUCTOR COMPANY, LIMITED.

This company is formed to acquire the business of the Horsfall Furnace Syndicate, Limited, carried on in Leeds, including the well-known Horsfall Refuse Destructor and the Loidis Forced Draught Boiler Furnace.

It is explained that the main object of the issue (announced in our other columns) is to obtain further working capital, and it is intended to acquire or establish suitable works, in order to cope with the large increase of business.

The company will purchase from the syndicate all its patents, covering the United Kingdom, France, Belgium, Germany, Italy, Switzerland, Russia, Austria, Hungary, United States, New South Wales, Victoria, New Zealand, Straits Settlement, and Hong Kong, the benefit of all its current contracts, and the whole of its assets, privileges, and rights, for £60,000, payable as to £20,000 in cash, £30,000 in fully paid ordinary shares of the company, and £10,000 either in cash or shares, at the option of the directors of the company. The capital is to be £100,000 in £1 shares, of which the vendor company takes as part of its purchase price, £30,000, and the balance of £70,000 is offered for subscription. Extracts from full reports (to be seen at the offices of the company's London solicitors) are published, and are from Lord Kelvin and Dr. Archibald Barr, Mr. Charles Estcourt, Sir Alexander Binnie and Dr. Shirley Murphy, engineer and medical officer respectively to the London County Council, and from Herr Andreas Meyer, chief engineer to the municipality of Hamburg, all speaking well of the destructor, and when we add that the contracts in hand with Corporations and other Public Authorities amount to nearly £88,000, and that additional orders to the tune of £50,000 are expected to be secured shortly, it will be seen what a promising opportunity for investment the above company presents.

THAMES IRON WORKS, SHIPBUILDING AND ENGINEERING COMPANY, LIMITED.

In our business columns this week will be found the prospectus of the Thames Iron Works, Shipbuilding, and Engineering Company, Limited. This company has been formed to take over the business

of the Thames Iron Works and Shipbuilding Company, Limited, together with the old-established engineering works of Messrs John Penn & Sons, Limited, of Greenwich and Deptford, which was recently acquired by the vendor company. Besides having built, or in course of building, 32 warships, &c., for the British Admiralty, the vendor company has built 60 other large vessels, many of them armour-clad, the total tonnage amounting to over 330,000 tons; while Messrs. John Penn & Sons have engined vessels for the British and other Governments with a total of 377,900 H.P. Such figures need no comment.

The authorised capital is £600,000 in £1 shares, of which 300,000 are ordinary shares and the remainder 5 per cent. cumulative preference shares. The purchase price is £750,000, payable as to £300,000 in ordinary shares, and as to the balance in cash; the present issue is 300,000 preference shares, and £200,000 4 per cent. irredeemable first mortgage debentures, at par, in 2,000 debentures of £100 each. The list closes on or before Wednesday, July 26th.

Electric Resistance and Heating Company, Limited.

This company is formed to acquire the patent rights for a new electric resistance for all countries with the exception of Austria-Hungary and the Balkan States, to re-sell, manufacture, and grant licences, and for the other purposes mentioned in the memorandum of association. The patents are for the manufacture of a composition for use as a resistance in order to regulate the amount of current supplied to electric appliances. The directors have consulted Mr. James Swinburne, M.I.C.E., Vice-President Inst.E.E., as to the material, who states that "the material, which is clay and blacklead, can be worked up and manufactured cheaply," and "can be made of various specific resistances." The total price to be paid by the company for the whole of the above-described patents and rights, including 100,000 kronen in fully-paid shares of the Rheostat Company of Hungary, has been fixed by the vendors, the Construction and Investment Company, Limited, at the sum of £95,000, of which £35,000 will be paid in fully-paid shares, as above stated, £27,500 in cash or shares at the option of the company, and £32,500 in cash, leaving £25,000 in shares to provide working capital. Out of the purchase price the vendors have to pay for the patents, rights, and shares above mentioned, the sum of £55,000, as to £20,000 in cash, and as to £35,000 in fully-paid shares, and also have to pay all expenses, including brokerage, but excluding legal fees and costs connected with the formation and flotation of the company and the issue of its share capital up to and including allotment.

The share capital is £120,000, in 120,000 shares of £1 each, of which 35,000 are taken as fully paid in part payment for the patents, the present issue being 85,000 shares of £1 each, at par. The list closes on July 25th. For other particulars see our business columns.

City and South London Railway Company.—The accounts for the half-year ended June 30th show a balance, after providing for the debenture interest and dividend on the preference shares, sufficient to allow the payment of a dividend on the consolidated ordinary stock at the rate of 2¼ per cent. per annum, carrying forward £1,107. The dividend for the corresponding period last year was at the rate of 2¼ per cent. per annum, with £1,005 forward.

Edison and Swan United Electric Light Company, Limited.—The directors recommend a dividend for the six months ended June 30th at the rate of 6 per cent. per annum on the "A" share capital, making, with the interim dividend, 6 per cent. for the entire year.

Eastern Telegraph Company, Limited.—The half-yearly ordinary general meeting of the above company was held yesterday at Winchester House, when the report of the directors was received and adopted. A report of the proceedings will appear in our next issue.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending July 15th, 1899, were £913 18s. 2d.; receipts for three days ending July 16th, 1898, £323 12s. 5d.; aggregate, July 1st, 1899 to date, £1,962 3s. 9d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending July 14th, 1899, were £3,579 5s. 4d.; corresponding period 1898, £3,126 1s. 1d.; increase, £453 4s. 3d.

The City and South London Railway Company.—The receipts for the week ending July 16th, 1899, were £861: week ending July 17th, 1898. £927; decrease, £66. Total receipts for half-year, 1899, £2,878; total receipts corresponding period, 1898, £2,828; increase, £50. Miles open, 3¼.

The Dover Corporation Electric Tramways.—The receipts for the week ending July 8th, 1899, were £219 10s. 2d.; week ending July 9th, 1898, £201 2s. 11d.; increase, £18 7s. 3d. Total receipts to date, 1899, £4,451 8s. 8d.; corresponding period, 1898, £3,540 3s. 10d.; increase, £911 4s. 11d. Miles of track open week ending July 8th, 1899, 8; week ending July 9th, 1898, 8. Car miles run week ending July 8th, 1899, 4,510; week ending July 9th, 1898, 3,741. Number of cars, week ending July 8th, 1899, 11; week ending July 9th, 1898, 10. The receipts for the week ending July 15th, 1899, were £258 15s. 8d.; week ending July 15th, 1898, £226 0s. 7d.; increase, £32 15s. 1d. Total receipts to date, 1899, £4,710 4s. 4d.; corresponding period, 1898, £3,766 4s. 5d.; increase, £943 19s. 11d. Miles of track open week ending July 15th, 1899, 8; week ending July 15th, 1898, 8. Car miles run week ending July 15th, 1899, 4,722; week ending July 15th, 1898, £3,908. Number of cars, week ending July 15th, 1899, 11; week ending July 15th, 1898, 10.

The Dublin United Tramways Company.—The receipts for the week ending Friday, July 14th, 1899, were as follows:—D. U. T. Co., horse cars, £2,044 13s. 9d.; ditto, electric cars, £1,216 7s. 8d.; D. S. D. Co., electric cars, £1,022 16s. 6d.; total, £4,283 17s. 6d.; corresponding week last year—D. U. T. Co., horse cars, £2 849 6s. 10d.; ditto, electric cars, £685 4s. 8d. D. S. D. Co., electric cars, £1,028 12s. 5d.: total, £4,563 3s. 11d.; increase, £279 6s. 5d. Aggregate to date, £8 689 12s. 4d.; aggregate to date last year, £9,040 2s.; decrease to date, £400 9s. 8d. Worked:—The mileage open is 18 miles electrically, 26 miles by horses, as against 11 miles electrically, and 31 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending July 16th, 1899, amounted to £1,598; corresponding week last year £1,691; decrease, £93.

The South Staffordshire Tramways Company.—The receipts for week ending July 14th, 1899, were £676 2s. 8d.; aggregate receipts for 28 weeks, £17,880 0s. 11d.; week ending July 15th, 1898, £667 7s. 3d.; aggregate receipts for 28 weeks, £17,117 11s. 11d.

STOCKS AND SHARES.

Wednesday Evening.

There has been an inclination on the Stock Exchange this week to read the South African news as more favourable to peace, and the telegraph market has steadied itself in the hope of a speedy solution of the Transvaal question. Should the Gordian Knot be cut, there may be a very sharp rise in some of these securities, but we look rather for a long period of unrest before the final basis of compromise arranged, and holders of telegraph securities must look for jumpy markets. The new Pacific cable, too, is edging its way to the front. So far as the Eastern Company's Ordinary stock is concerned, the price has been maintained by reason of the directors' excellent report. The two deputations to Sir Michael Hicks-Beach seem to have counteracted each other in the eyes of the market, although it is feared that the company will have to lower its rates to India in the near future.

Eastern Extensions are a weak market, and the report is awaited with some anxiety. Wireless Telegraphy shares are also dull, and the price has relapsed to 5¼ middle. The Direct United States Cable dividend and bonus are regarded as being very satisfactory. The City and South London Railway dividend, at the rate of 2¼ per cent. for the year, is fairly good, and is about what the Stock Exchange looked for. There was, accordingly, no movement in the price when the dividend was announced on Tuesday afternoon. A slight increase in the carry-forward is the only change since this time last year. Central London descriptions display no vivacity, and a small selling order was sufficient to knock 5s. off the price of the Preferred half-shares. Waterloo and City stock marks no alteration. It is satisfactory to note that the Brompton and Piccadilly Circus Railway will not have to face the opposition that was at one time threatened by the House of Lords, and the company seems at length to have a plain course to run over.

Electric lighting shares exhibit but little change on the week, what alterations there are being mostly downward. In the present temper of the market the quotations that are sent out officially must be regarded as somewhat nominal, nor must sellers be disappointed if their orders are executed at the lowest figure marked, since there is very little support being accorded to the list of electric lighting shares. The Metropolitan Companies' shares are all in a weak state; in fact, the only hard quotation in the list is that for Westminsters, which have risen ½ during the week. City of London shares went from bad to worse, nor did the company's latest circular have much effect in brightening the price. The document is regarded with very mixed feelings, and in some quarters the opinion is expressed that it adds nothing to the company's dignity.

The two classes of the Metropolitan Electric Supply's Ordinary shares are now quoted at the same price.

Dividends and rumours of dividends are the order of the day, and the Edison & Swan has again succeeded in declaring 6 per cent. on its "A" capital, which makes 6 per cent. for the year. The yield on the partly-paid shares at to-day's price works out to over 7 per cent. The Debenture stock has relapsed, last week's rise having brought in several sellers. The manufacturing department is quiet, the changes marked being principally on account of the deduction of dividend. Callender's Cable Construction are better. A new comer in this section is an issue of 6 per cent. Preference shares of the British Westinghouse Electric and Manufacturing Company. As a speculative investment, the shares appear to merit some attention, and a small premium has been established in the market, although very few shares have changed hands up to the present.

British Electric Tractions have been rather sold by people who are disappointed at the rebuffs which have lately fallen to the company's lot, but, as we have pointed out in a previous issue, these must be expected to come occasionally. Buenos Ayres and Belgrano keep firm at 4⅜, and Anglo-Argentines are a mere shade below this price. Imperial Tramways at 25 and Potteries Electric Traction are both exceedingly firm, and New General Tractions remain at 4.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, July 13th.	Closing Quotation, July 19th.	Business done during week ended July 19th, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	61 — 64	61 — 64	...	...
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	112 —113	112 —113	112⅞	112½
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	13¼— 13⅜	13¼— 13⅜	13⅜	13⅜
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15 — 15½	15 — 15½	15 5/16	15
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	108 —112	108 —112	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2½— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	188 —193	188 —193	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105⅛	105¼
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	¼— ¼	¼— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,981	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref. ...	5	10 %	10 %	...	9½— 10½	9½— 10½	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3¼%	3½%	11½— 12	11½— 12	11¼	...
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	7 %	150 —155	150 —155	153½	150
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	100 —104	99 —103	99⅞	99¾
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	101 —104	101 —104	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	115 —120	115 —120	...	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14¾— 15¼	14½— 15 xd	15	14½
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —100	99 —100	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
820,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	116 —121	116 —121	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	103 —106	103 —106	103	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	102 —105%	102 —105%	102	...
180,227	Globe Telegraph and Trust	10	4½%	4½%	5⅛%	10⅜— 11⅛	10⅜— 11⅛	11 3/16	10⅜
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15 — 15½	15 — 15½	15 7/16	15
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 32	30 — 32	30½	...
83,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	49	48
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	109 —112	109 —112	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ½	¼— ½	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5½%	6 %	6 %	5⅛— 5⅜	5⅛— 5⅜	5¼	5⅛
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12½— 13½	12½— 13½	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12½— 13½	12½— 13½	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼— 5½	5¼— 5½	5 5/16	5¼
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	99 —102	99 —102	100½	99
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1	⅞— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	105 —108	103 —106	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	7⅝	...
3,381	Submarine Cables Trust	Cert.	...	...	...	130 —135	130 —135	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	5 — 5¼	4¾— 5¼xd	4⅞	...
151,733£	Do. do. 5 % Debs.	Stock	...	...	...	103 —106	103 —106	105½	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	100 —103	100 —103	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¾— 1	¾— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	101 —104	101 —104	...	...
889,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	103 —106	103 —106	105	...
88,321	West India and Panama Telegraph	10	1 %	2%	...	1¼— 1½	1¼— 1½	1 7/16	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10¼— 10⅝	10⅛— 10⅝	10⅜	10¼
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8½— 9½	8½— 9½	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	103 —106	103 —106	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

80,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	9½— 10½	9½— 10½	10	9¾
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5⅝— 6¼	5⅝— 6¼	...	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7½— 8½	7½— 8½	8¼	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½%	4½%	...	112 —114	112 —114	113	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	13 — 15	12 — 14	14	12⅞
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	13 — 15	13 — 15	14½	14¼
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	123 —128	123 —128	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	*nil*	*nil*	11 — 11½	11 — 11½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	14 — 15	13½— 14½	14	13⅜
220,000	Do. 4½% Deb. Stock, Prov. Certs (£60% to be paid) Rd.	...	...	...	...	52 — 54	52 — 54	...	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	7 %	5¼— 5⅝	5½— 6	5 13/16	5⅝
19,661	House-to-House Electric Light Supply, Ord., 101 to 19,661	5	...	4 %	6 %	7½— 8½	8¼— 9½	7 15/16	7⅞
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	8½— 9½	8½— 9½	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 4	3½— 4	3 9/16	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 7	6½— 7	6⅝	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	104 —106	104 —106	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	16 — 17	15½— 16½	...	...
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	15½— 16½	15½— 16½	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	4½%	...	116 —118	118 —120	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15½— 16½	15½— 16½	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½%	14½%	14½%	16½— 17½	16½— 17½	17¼	16¾
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	10	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	4⅛— 4⅜	4⅛— 4⅜	4⅛	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14 — 15	14½— 15½	14⅞	...

* Subject to Founder's Shares.
‡ Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being *vred* as capital.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation July 12th.	Closing Quotation July 19th.	Business done during week ended July 19th, 1899. Highest	Lowest
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	3¼— 3⅜	3¼— 3⅜	3½	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
30,000	British Electric Traction	10	...	...	6 %	18 — 19	18 — 19	...	...
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	14¼— 14⅜	14¼— 14⅜	14⅜	...
20,000	Do. do. do. Nos. 40,001—60,000	10	...	...	...	13⅜— 14¼	13⅜— 14¼	13⅞	13⅞
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	127 —130	127 —130	129⅜	129
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	*nil*	*nil*	...	1⅜— 2	1⅜— 2	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	*nil*	4 %	...	2⅛— 2⅜	2⅛— 2⅜	2⅛	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	101 —104	101 —104	101	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½%	15 %	14 — 15	14¼— 15¼	15	14⅜
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —115	112 —115	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10½— 11	10¼— 11	10⅜	...
178,303	Do. do. do. £8 paid	10	...	...	...	8½— 9	8½— 9	8 11/16	...
61,033	Do. do. Pref. half-shares £3 paid ...	...	...	...	...	3 — 3½	2⅞— 3½	3¼	3⅛
71,447	Do. do. Def. do. £5 paid ...	...	...	...	...	5¼— 5⅜	5¼— 5⅜	...	...
630,000*l*	City and South London Railway	Stock	1 1/16%	1⅛%	2⅛%	67 — 69	67 — 69	68½	68
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 £5 pd.	10	...	...	...	4⅜— 5¼	4⅜— 5¼	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	4 — 4½	3⅞— 4	3 15/16	3¾
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	99 —102	99 —102	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½%	6 %	...	2 — 2½	2 — 2½	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5½%	6 %	...	4 — 5	4 — 5	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	97 — 99	95 — 97	96½	96
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜	2⅛	2⅛
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	3 — 3½	3¼	3 1/16
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —106	101 —104 xd	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅝— ¾	⅝— ¾	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13 xd	12⅜	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	24½— 25½	24½— 25½	25¼	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	19 — 21	19 — 21	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	4½%	...	112 —115	111 —114	111	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21½— 22½	21 — 22 xd	21⅞	21½
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	101 —105	101 —105	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞%	3¼%	3¼%	8⅜— 8⅞	8¼— 8⅜	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	14 — 14½	14 — 14½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	38 — 42	37 — 41 xd	...	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	104½	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¼— 9⅜	9¼— 9⅜	9 11/16	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5⅝— 6¼	5⅝— 6¼	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	104 —107	104 —107	...	...

† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10⅛.
British Aluminium, Ordinary, 10½—11½; 7 % Pref., 11¼—12½ nom.
House-to-House, 4½% Debentures of £100, 103—107.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12⅝—13⅛; 1st Preference Cumulative 6%, £5 (fully paid), 7⅞—8⅛. Debentures, 103—106. Dividend, 1898, on Ordinary Shares 10%.
National Electric Free Wiring, 10s. paid, ⅜—½.
Smithfield Market Electric, 3—4 nom.
*T. Parker, £10 (fully paid), 19 xd.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (February 2nd, 1899).

MARKET QUOTATIONS, Wednesday, July 19th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a „ Nitric .. .. .. per cwt.	22/-	22/-	..
a „ Oxalic .. .. .. per cwt.	33/-	33/-	..
a „ Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	37/-	37/-	..
a Ammonia, Muriate (crystal) .. per ton	£26	£26	..
a „ „ .. .. per ton	£24	£24	..
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a „ (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£26 5	£27	15/- dec.
a Lead, Nitrate .. .. .. per ton	£23 10	£23 10	..
a „ White Sugar .. .. per ton	£31	£31	..
a „ Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	8¼d.	8¼d.	..
a „ Caustic (75/80 %) .. per ton	£24	£24	..
a „ Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6 5	5/- dec.
a „ Recovered .. .. per ton	£5 10	£5 10	..
a „ Lump .. .. .. per ton	£5 0	£5 0	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a „ Crystals .. .. .. per ton	£3	£3	..
a „ Bichromate, casks .. per lb.	2½d.	2½d.	..
METALS, &c.			
b Aluminium Wire, in ton lots .. per ton	£224	£224	..
b „ Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£70 to £145	£70 to £145	..
c Brass (rolled metal 9" to 12") basis per lb.	8½d.	8½d.	..
c „ Tube (brazed) .. .. per lb.	10½d.	10½d.	..
c „ Wire, basis .. .. per lb.	8½d.	8½d.	..

METALS, &c. (*continued*).	This week.	Last week.	Increase or Decrease.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f „ Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£88	£86	£2 inc.
g „ Wire (basis price) .. per lb.	10½d.	10½d.	..
g „ Sheet .. .. .. per ton	£88	£86	£2 inc.
g „ Rod .. .. .. per ton	£88	£86	£2 inc.
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	6/-	6/-	..
h India-rubber, Para fine .. per lb.	4/0½ to 4/1½	4/0½ to 4/1½	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i „ Pig (Cleveland warrants) per ton	72/1½	70/6	1/7½ inc.
i „ Forgings, according to size per ton	From £11	From £11	..
i „ Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i „ Wire galvanised No. 8 .. per ton	£11 5	£10 12 6	12/6 inc.
g Lead, English Ingot .. .. per ton	£14 10	£14 7 6	2/6 inc.
g „ „ Sheet .. .. per ton	£15 7 6	£15 7 6	..
l Mica (uncut slabs 8" long) .. per lb.	From 8/-	From 8/-	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£8 6 6	£8 5	1/6 inc.
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ r'l'd strip & sheet per lb.	From 1/2½	From 1/3½	..
o Platinum .. .. per oz.	£3 10	£3 10	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£135	£126 10	£8/10 inc.
g „ foil .. .. per lb.	1/6	1/6	..
n „ wire Nos. 1 to 16 .. .. per lb.	1/9	1/7	2d. inc.
p White Anti-friction Metals—			
"White Ant" brand .. per ton	£40 to £67	£40 to £67	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	7½d.	7½d.	..
j „ Best Flax, 6 lea. .. per lb.	4½d.	4½d.	..
j „ Hemp, 3 ply 10 lbs. .. per lb.	3½d.	3½d.	..
j „ „ Russian, 10 lbs. per lb.	4½d.	4½d.	..
j „ Jute, 180 lbs. rove .. per ton	£12	£12	..
j „ Manila, 24 thread .. per ton	£32 10	£32 10	..
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£30	£30	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yeo & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
l Messrs. Sanders, Wake & Co.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

ACCUMULATORS FOR AUTOMOBILES.

WRITING on the subject of automobiles in the *Revue de Physique et Chimie*, M. L. Inman premises that the automobile is undoubtedly one of the foremost subjects of the day, and the subject of the accumulators must of necessity be equally of interest. He treats only of accumulators, not of primary batteries, which are out of the question, being too feeble in power, and furnishing energy at too high a rate. Their recharging would also be often impracticable.

So far does the accumulator hold the field, that M. Hospitalier has proposed the term accumobile, and M. Inman adopts it straightway.

The improvements of the past 15 years have rendered the accumobile practicable. Reverting to the year 1881, the best accumulator of that time was the Faure, which had a specific capacity of 39 ampere-hours, and a specific current of ·35 ampere, per kilogramme of total weight. This gives 7·5 watt-hours per kg., and ·65 watt per kg. for the energy and the specific power. In 1883 the Faure-Sellon-Volckmar gave 12 watt-hours per kg. at the rate of ·6 watt per kg., and 8·5 watt-hours per kg. at the rate of 2 watts.

Constantly growing, the figures now obtained are:—

30 watt-hours per kg. of total weight at 1·5 watt per kg.
25 " " " 5·0 "
20 " " " 10·0 "

for the Fulmen accumulator of 1897 type. The specific power, at the same time, is able momentarily to attain 20 to 25 watts per kg.

Theoretically it is known that 1 ampere-hour requires 3·86 grammes of lead and 4·46 of lead oxide, a total weight of 8·32 of active material. In practice a complete utilisation of the active matter is unattained, electrolytic action being incomplete and the active material being of considerable thickness. Further, the sulphate and oxide of lead cause the electromotive force to diminish as the internal resistance increases. Under the very best conditions, a coefficient of utilisation of ·5 or ·6 is obtained, especially when the *régime* is light and the thickness of active material is small. Thus a minimum of 15 grammes of active matter must be counted upon per ampere-hour. In the lightest plates with lead grids it is found that the active matter will hardly exceed 65 per cent. of the total weight of the plates.

The minimum weight of plates per ampere-hour will thus be $\frac{15}{\cdot 65} =$ 23 grammes, of which the specific capacity at a maximum will be $\frac{1\,000}{23} = 43$ ampere-hours per kg.

Adopting 1·5 as the accessory coefficient, including liquid, cell, and connections, the lightest plates will produce cells having a total weight 23 × 1·5 = 35 grammes per ampere-hour, bringing the specific capacity and energy to 28 ampere-hours per kg., and 54 watt-hours per kg. of total weight. These figures have still to be attained, and it is very difficult to secure them industrially with lead accumulators, because of the economic questions that arise. The duration of plates is a prime factor, and it has not sufficed to augment the specific energy of accumulators in order to render the accumobile a practical success. Diminished cost of maintenance has also been necessary with a view to comparison with other systems—horses, oil motors. Otherwise, the advantages of electricity are incontestable, its safety, absence of noise, vibration, heat, and smell, as well as in simplicity of handling.

Taking actual results furnished by accumulators, it is necessary to assume the battery as 30 to 40 per cent. of total weight of vehicle, say, 350 kg. The specific energy will be at 25 watt-hours per kg., 350 × 25 = 8,750 watt-hours. The recent meeting of the French Automobile Club has shown the results as follows for different vehicles:—Total weight of vehicles, 1,090 to 1,802 kg.; energy consumed at the terminals of the charging generator for a run of 60 km., 8·78 to 13·26 kw.-hours; consumption in watt-hours per ton-km., 134 to 105 at the generator, and about three-fourths to two-thirds this amount on the vehicle itself. Speed from 13·8 to 19·9 km. per hour, the mean consumption on a course in Paris being about 118 watt-hours per ton-km., as shown on a course of 75 km. at a speed of 15 km. per hour. The small length of possible run per charge limits the use of accumobiles to a certain radius from a charging station. Special types of cell constructed for vehicular traffic are reviewed. All the vehicles in the meeting referred to had Fulmen accumulators, distinguished by their great power and specific energy. Their plates are made up of two grids of cellular structure in antimony lead applied one against another, and presenting rectangular cells to receive the active material. These plates measure 18·5 cm. × 9·5 cm. × 0·4 cm. in thickness, and have 24 cells.

A test made by M. Hospitalier has determined their weights as follows:—

	135 grammes +	135 grammes −
Plate		
Active material	340 " +	255 " −
Total ...	475 " positive	390 " negative

The plates of the sizes named above are made up in six types of cell measuring 30 cm. × 11 cm. × from 8 to 18 cm., containing from 3·7 kg. to 9 kg. of plates. The total weight of an element is 5·3 to 12·8 kg. The capacity in ampere-hours is 70 to 175 for a discharge in five hours, and the energy in watt-hours 133 to 333, the specific capacity in ampere-hours per kg. being 13·5, the current in amperes 2·7, the energy in watt-hours 25, and the power in watts 5·1 per kg.

The Society for the Electrical Treatment of Metals has an accumulator at once economical and durable. The negatives are of paste provided by the reduction of lead chloride. The positives are of Planté type made up of little fluted bands of lead specially arranged and united. The active surface is considerable, the electrolyte circulates easily, and deformation from progressive peroxidation is not found to take place. The output is large. The specific energy given by each plate is as follows:—

28 watt-hours per kg. at 2 watts per kg. of electrodes.
26·5 " " 3 " " "
25 " " 4 " " "
22·5 " " 6 " " "
20·5 " " 8 " " "
19 " " 10 " " "

An ordinary cell comprises 13 plates, 6 positive 7 negative. They are 11 cm. by 21 cm. high. Each element measures 17 cm. long, 12·5 wide, and 28 high, and weighs 17 kg., of which 8·4 are positive and 3·6 are negative plates. Special precautions are taken in their mountings. The plates are carried by a bracket of ebonite of suitable form and are separated by perforated corrugated ebonite plates. Plates of the same polarity are soldered to a lead bar carried by two bars resting on the edges of the cell. A 13-plate cell discharged in 3½ hours has the following output, &c.:—

Normal current in amperes	38
Specific " " per kg. of plates ...	3·2
" " " " total	2·2
Capacity in ampere-hours	132
" " per kg. of plates	11
" " " total	7·7
Normal power in watts	70
Specific " " per kg. of plates	5·8
" " " " total	4·1
Energy in watt-hours	250
Specific energy in watt-hours per kg. of plates ...	20·8
" " " total	14·7

For specially high specific energy the Society has established a type, of which the positives are pasted, and exceed by 30 per cent. the previous type for discharge periods of 5 hours and under.

In the Pulvis accumulator the active material is lead powder or granules without oxide. This powder is produced by means of a jet of compressed air blown on a fine stream of melted lead, after the manner of slag wool. The resulting powder is mixed with powdered pumice stone of special preparation, mixed with water and compressed into the plates with great pressure.

The cells are of ambroin, and the plates are separated by ebonite sheets, corrugated and perforated. The ordinary type is made up of seven plates, three positive, four negative. They are 19 cm. long and 15 cm. high. Each cell measures 10 cm. by 21 cm. by 25 cm. high, and weighs 16 kg., of which 7·5 are positive and 4·1 kg. negative.

The figures of output are:—

Normal current in amperes	30
Specific " " per kg. of plates ...	2·5
" " " total	1·9
Capacity in ampere-hours	150
" " per kg. of plates	12·8
" " " total	9·3
Normal power in watts	585
Specific " " per kg. of plates	5·0
" " " total	3·6
Energy in watt-hours	292
Specific energy in watt-hours per kg. of plates ...	25
" " " total	18

In the Pisca cell the active matter is embedded in a honeycombed plate. Thin plates are at once less durable, but of greater specific capacity. Pisca plates are 3 to 4 mm. thick, the positives being a trifle the thicker. The cells are of semi-hardened India-rubber, with separators in one piece, and have covers which completely prevent the acid from spilling. The cells are made with 9, 11, 13, 15, and 17 plates, an 11-plate cell having plates 20 cm. square. The cell has a length of 22 cm. × 11 cm. × 33·5 cm. high; it weighs 18 kg., the plates weighing 13·7 kg. With different rates of discharge, the capacity of an element is as below:—

Utilisable capacity. Ampere-hours.	Discharge in amperes.	Duration in hours.
107·5	71·6	1·5
116	38·6	3
138	23	6

The constants of each element for a three hours' rate of discharge are:—

Normal current in amperes	38·6
Specific " " per kg. of plates ...	2·8
" " " " total	2·1
Capacity in ampere-hours	116
" " per kg. of plates	8·5
" " " " total	6·5
Normal power in watts	78·3
Specific " per kg. of plates	5·3
" " " total	4·1
Energy in watt-hours	220·0
Specific " per kg. of plates	16·0
" " " total	12·2

The accumulators of Valls et Cie., specially devised for automobilism, are of three types, normal, light, and extra light. The negative plates are of soft lead with very small cells in which the active material is solidly imprisoned, thus providing a large surface of contact between the material and its support. All three types have positive plates of soft lead of a shape to compensate for the loss of capacity due to the fall of the active matter by the gradual formation of the support. For the lighter types the negative plates are the

same in form. The positives, of the normal type, have a form similar to those with fixed post, with central piece and branching grooves arranged in chequer form and stiffened by horizontal and vertical bands. To prevent the fall of the active matter each plate is covered by a plate of perforated ebonite, and the separators are ebonite, also the cells and covers.

The three types have the following leading characteristics:—

	Normal.	Light.	Very light.
Number of plates	23	19	13
„ positives ...	11	9	6
Length of plates in cm. ...	14·5	14·5	14·5
Height „ „ ...	„	„	„
Length of cell	16	16	16
Breadth „	14·5	10·5	7·5
Height „	22	22	22
Weight of one positive plate	0·650	0·400	0·400
„ „ negative „	0·400	0·400	0·400
„ total of plates ...	11·95	7·6	5·2
„ „ cell ...	15·95	11·4	8·0
Duration of discharge ...	5 hours.	6 hours.	5½ hours.

Normal current in amperes ...	25	20	15·6
Specific current in amperes per kg. of plates	2·1	2·6	3·0
Specific current in amperes per kg. total	1·6	1·75	1·9
Capacity in ampere-hours... ...	125	120	85
Capacity in ampere-hours per kg. of plates	10·4	15·8	16·3
Capacity in ampere-hours per kg. total	8·0	10·5	10·6
Normal power in watts	48	38	29·6
Specific power in watts per kg. of plates	4	5	5·7
Specific power in watts per kg. total	3	3·3	3·6
Energy in watt-hours	240	228	163
Specific energy in watt-hours per kg. of plates	20	30	31·3
Specific energy in watt-hours per kg. total	15	20	20·4

In the Blot accumulator both plates are of the Planté type with large surface of active material and a thickness of a few hundredths of a mm. only. Hence the coefficient of utilisation is large. The plates are of antimony lead. The Blot Company make special types to give a specific capacity of 12 ampere-hours per kg. of plates at a rate of discharge of four hours. The author concludes that makers of accumulators, having regard to the durability of the plates, do not care to exceed a mean of 15 watt-hours per kg. Counting one-third of the total weight of a car to be accumulators, the distance run by one charge will be 40 to 50 kilometres. The Automobile Club has organised for April next another set of trials of international character. The points in view are:—Duration of the elements; industrial output; ratio between energy furnished and delivered; operation; weight and capacity ratio of accumulators. The conditions are those under which automobiles are called upon to work. The trials, which will last six months, will enable the fixing of the limits of the economical performance of accumulators and their practical usage.

THE MUNICIPAL ELECTRICAL ASSOCIATION.

CONDENSERS FOR ELECTRIC LIGHT AND POWER STATIONS.

By J. F. C. SNELL, A.M.I.C.E., M.I.E.E., M.I.M.E.
Borough Electrical Engineer, Sunderland.

A GOOD deal of labour is expended in obtaining an extra one per centum of efficiency of electrical plant, and it is anomalous to find so many electrical stations, which are among the most modern in equipment of all generating centres of power, exhausting steam into atmosphere, and thereby reducing the efficiency of the steam plant wholesale. When one considers the fundamental equation $\frac{T-T_1}{T-T_2}$ which gives the increase of efficiency obtained by a condensing engine over and above that of the same engine working with an atmospheric exhaust, it seems that in the most difficult of cases, *i.e.*, where circulating water has to be purchased, and the station site is limited in extent, it is financially unsound, and also unsound engineering to ignore the claims of the condenser. Take a simple example of an engine working with a chest pressure of 135 lbs. absolute, and with 6 lbs. back pressure in the exhaust, and compare the results with those obtained from the same engine having the same initial pressure, but exhausting into a 25-inch or 26-inch vacuum, or against a vapour pressure of 3 lbs. absolute, what increase of efficiency results? The temperature of steam at 135 lbs. absolute = 350° F., and that of 21 lbs. absolute = 231° F., and that of 3 lbs. absolute = 127°.

The theoretical efficiency of the engine working with a condenser would be $\frac{350-127}{350-231}$ = 1·87 times greater than the same engine working to atmosphere. In the classical papers of the late Mr. Willans, published in the *Proceedings of the Institution of Civil Engineers*, Vol. xiv., 1893, curves and results were shown of trials of throttle-governed engines in which the condensing curve (which is a straight line in this case) is much below that of the non-condensing curve, and the initial quantity of steam to overcome friction being very much less, and the constant increment per H.P. being the same in both cases, the two lines are parallel, showing that the value of condensation of steam increases with a decrease of load, a very valuable fact in view of the variable load of an electric light station and the present tendency towards large units of power. It is a pity that the valuable tables given weekly in *Lightning* do not give a column showing whether a station is condensing its steam or exhausting to atmosphere, for the former must have the advantage in coal consumption. Of course this is not all gain, a certain debit having to be made for the auxiliary machinery required to drive air or circulating pumps, or both, which auxiliary power amounts to some 2 or 3 per cent. of the whole.

There are other considerations which should induce one to adopt condensers, such as the nuisance which is caused sometimes from the exhaust steam blowing about and becoming condensed and falling as a greasy rain; or, again, the atmospheric vibration which is frequently caused by an exhaust pipe. A saving is effected in less cleaning of boilers; the hot well water can be used for feed, and only a small amount of make-up water is required. Other advantages could also be brought forward.

The locality must needs affect the type of condenser adopted. If a natural source of circulating water is not available, can ground space be obtained for artificially cooling the water?

This and other considerations must settle the question.

Condensers may be classed broadly into two kinds:—

1. Those in which the circulating water is always separated from the exhaust steam.

2. Those in which the circulating water is mixed with the exhaust steam.

The first class contains the surface condenser and the evaporative condenser.

The second class contains the old jet condenser and the more modern ejector condenser.

SURFACE CONDENSERS.

In the author's opinion there can be no inducement to adopt any other class of condenser if plenty of circulating water can be had. If not, artificial cooling arrangements should be adopted. If economy of circulating water is necessary, this system is very good, and though it does not approach the simplicity and excellence of surface condensing plant supplied from liberal and natural sources of cooling water, yet it appears to the author to be the next best system. In the *Railway World*, of February, 1899, a case is cited of the Madrid power house, where, after a 12 hours' full load run, the temperature of the tank from which the circulating water was drawn had not increased. The water, after passing through the condensers, is in that case made to fall over a series of metal sheets contained within a tower through which a circulation of air is forced by fans.

The advantage of surface condensers is, that the condensed steam can be returned to a hot well, and after passing through a carefully arranged oil filter, can be used again as boiler feed. It is true that both air and circulating pumps are required, and in the case of cooling towers, fans as well; also that this type requires a larger percentage of auxiliary power than other types. It is also more costly in outlay, but eventually, and especially in hard water districts, it will probably be found better to instal than a type in which condensed steam and circulating water are mixed together. The principle of using the heat units of the hot well water, instead of wasting them as well as the latent heat units taken away by the circulating water, is one that must be right.

The author has recently been obliged to go into the question of extensions at Sunderland, where every available foot of ground on the existing site will be taken up as soon as the extensions are completed, and the only alternative of exhausting to atmosphere (for which the station was originally designed) is the adoption of artificial means of cooling the circulating water, or the use of condensers of the evaporative type. The author has decided to adopt self-contained surface condensers, one to each pair of 500-H.P. steam dynamos, and a cooling tower with fan draught for top loads or special climatic conditions. Sunderland water is very hard indeed (about 25° Clark's scale), and, as considerations of space have made it imperative to adopt marine boilers, it is more necessary to use the condensed steam again as feed. The price of the condensing plant, steam driven, including cooling towers and all pipe work, will be about £2 5s. per E.H.P. installed.

In large stations it will certainly be best to have each engine completely equipped with surface condenser, air and circulating pump, even if the pumps be separately driven. Simplicity of design is most essential, and any system allowing for changing over from one condenser to another, or many, will in the end introduce unnecessary complexity of design. Each engine, condenser and pumps and atmospheric by-pass uptake should be separate. By having the condenser close to the L.P. cylinder, a gain in vacuum in the cylinder results. There is less work for the air pump, and there are less joints on the exhaust to be maintained.

Should the condenser be a portion of the engine and the pumps

driven from it, or should they be independent of it? The author understands that even in some modern marine practice, the condenser is being made independent of the main engine, and the pumps are separately driven. The present tendency of electrical men—writing from a station engineer's standpoint only—is towards high speed, This in itself practically disallows the pumps being driven from the main engine; again, it is convenient and economical to have the condenser below the engine room floor instead of taking up unnecessary space. A good drainage is thus given to the low pressure cylinder, and though not all-important, a gain in the appearance of the station. The engines can also be worked to atmosphere more readily.

In stations of small dimensions where the price of a separate condenser for each small unit would be prohibitive, it becomes necessary to have a common exhaust pipe, and perhaps several condensers connected thereto. This is not to be desired, as the more valves and complications, the more chances of losing the vacuum, and that perhaps at a critical moment, when a drop in pressure over the whole system might result.

The question whether the condensers are to be separate, or built up with the engines, therefore depends much on the type of engine itself. To sum up, the author is of opinion that high speed or moderately high speed engines, with separate condensers to each, driven by a motor or auxiliary engine, and with the condensing plant below ground, and a separate atmospheric by-pass, commends itself as the most reasonable and simplest design.

The systems of cooling circulating water will be dealt with later in the paper.

Surface condensers, including air and circulating pumps, cost approximately £1·6 per E.H.P. if steam driven, or £3·75 per E.H.P. if motor driven. They take up approximately 0·03 square feet per horse-power. The cooling surface in the best practice is 2 square feet per horse-power, and the weight of circulating water should not be less than 25 times the weight of steam condensed, and more if the surrounding temperature and temperature of circulating water be high.

The importance of having brass tube plates, with the tubes ferruled into the plate, plenty of air pump volume (usually taken at $\frac{1}{10}$th the L.P. volume), brass liners, brass buckets, and phosphor bronze air pump rods, scarcely needs pointing out. A type of air pump now much in favour is that known as Edwards's, which does away with foot and bucket valves, and therefore reduces to a minimum a chief source of trouble in air pumps. The head or delivery valves of course remain, but another advantage is that these can be renewed from a side door without stopping the pump. India-rubber valves are of no use with oily water, as they waste and rot so quickly. Munts metal sheets, or vulcanised fibre valves are found best in practice. It is best to let the air pump have an easy discharge to the hot well, as if much head of water be allowed on the delivery side, trouble results in getting rid of the air and the vacuum is consequently impaired.

The barrels, buckets, and valves of the feed pump should also be of brass, as the hot well temperature will be some 130° or 140° F.

In a recent description of a surface condenser with motor driven air and circulating pumps for Glasgow, the curves show a modulus of 66 per cent., that is, $\frac{\text{Pump H.P.}}{\text{Elec. H.P.}}$. These sets are each to care for 15,000 lbs. of steam, or at 22 lbs. per E.H.P., say, about 700 E.H.P., and have each a surface of 1,250 square feet, that is, 1·78 square feet per E.H.P. The air pump took 13 H.P. at full load, and I have calculated out the circulating pump at 7, or a total of 20 H.P. of auxiliary plant for a 700 H.P. engine, *i.e.*, slightly under 3 per cent., a usual figure. The air-pump motor runs at 800 revolutions per minute, and the pump at 150 revolutions, a rather high rate for an air pump; the 7-inch centrifugal pumps deal with 1,000 gallons per minute against a 10-foot head, and run at 530 revolutions per minute.

Evaporative Condensers.

The next type of condenser which keeps condensed steam separate from the circulating water is one which has sprung up only recently, and is still in rather an experimental stage. At least little has been written on the matter excepting, as far as I know, a paper before the Institution of Civil Engineers, by Mr. Henry Davey, in 1896, one before the Institution of Junior Engineers by Mr. Fraser, and an admirable paper recently read before the Institution of Mechanical Engineers by Mr. Oldham. The author has had experience with three types of evaporative condensers. The principle is, of course, the passage of a film of water over tubes arranged either horizontally or vertically, which by evaporation carries off the latent heat of the steam contained within the pipes. In some cases the pipes are enclosed within a casing and the cooling is aided by forced draught obtained by means of a separately driven fan. It is claimed that the amount of circulating water evaporated is less than the amount of feed water, but of course this is obtained only by means of a considerable amount of air cooling. The condensers can be, and usually are, fixed on the roof of the engine house. The average vacuum obtained is from 18" to 22", and air pump and circulating pump are both required, but the work done by the circulating pump is small, being that due to the height of the condenser itself. The objection to this type, in the author's opinion, is the fact that the condenser is some distance from the engine, and on account of the benefit of wind draught and ground space occupied, it is placed on the roof, and natural drainage of the exhaust is impossible, and the vacuum in those with which the author had to deal, at any rate, has not been nearly so good as that obtained with a surface condenser. So far as his experience with this class of condenser goes, the vertical arrangement of tubes is better than a horizontal construction. Various means have been devised to keep the water spread over the tubes, so as to use every inch of cooling surface:—tape, spiral guides, troughs at intervals, and other devices. The amount of cooling surface per E.H.P. is found to be about 2·75 square feet, as against 1·75 to 2 square feet for a surface condenser. The air pump should be larger, on account of the large amount of exhaust pipe usual in such cases, and so arranged as to drain the exhaust pipe at its lowest level. The circulating pump is very much smaller than in the case of a surface condenser, being only required to circulate something like one-twelfth of the amount of water.

There is a well-known type of evaporative condenser at Kensington Court, which is frequently used as an air condenser only, being in its present situation impossible to circulate water, owing to the proximity of important residential buildings, and the fear of creating a nuisance. This type of condenser for congested districts must of necessity be a valuable one, and next to surface condensers, in the author's opinion, will prove to be the best when more developed.

A case is cited in Mr. Oldham's recent paper read before the Institution of Mechanical Engineers, of an evaporative condenser connected to two Willans engines of 350 H.P. This condenser was 140 feet away from the engines, and the distance from the engines to the condenser and thence to the air pumps was 350 feet. These engines could run at 100 H.P. without any cooling water, the condenser simply acting as an air condenser. It, therefore, seems that only sufficient tube area is necessary to enable this type of condenser to be used without employing any circulating water at all.

The auxiliary H.P. required for driving the pumps is about 2 per cent., and the circulating water necessary may be taken at 1½ times the steam condensed.

Another case is cited of a Theisen plant dealing with 3,000 H.P. These condensers are supplied with a 12-inch fan, and the auxiliary plant requires only 16 H.P. for the centrifugal pump and fans, and 15 H.P. for the air pump, or 1·03 per cent. only of the total power. The cost of an average evaporative condenser may be taken at £1 8, with motor-driven auxiliaries, including air pump, circulating pump, and fans, and the area taken up about 0·15 square foot per E.H.P.

The make-up water of either of the above-mentioned types of condenser can be, if necessary, in hard water districts, treated by a softener or by an evaporator, since so small a quantity is required.

Ejector Condensers.

The next type to consider is the ejector, which the author thinks ranks third on the list. He does not, however, like it so much as the other types because of the intermixture of circulating water and steam and consequent loss of a hot feed. Thus one of the two great advantages of condensation is lost. This is, however, a very neat and a very cheap condenser, occupying very little room. The principle, of course, is the supplying to a specially-shaped vessel a stream of water under good head or pressure passing through the inner sides of a series of cones around the outside of which the exhaust steam circulates. The *vis viva* of the falling water, with the added energy due to the differences between atmospheric pressure and vacuum in condenser, carries away the combined steam, air and water. No air pump is therefore necessary, but a circulating pump similar in size to that used with a surface condenser is required, *i.e.*, circulating water about 25 times the weight of steam condensed. At two stations with which the author was connected the engines exhausted into a common pipe to which several ejectors were fixed, varying in size. The author does not like this, but considers that a separate ejector to each engine, as arranged by Mr. Wordingham, at Manchester, is by far the best. There is one important point in connection with this type; it is necessary to seal the delivery from the condensers with water. In cases of failure of the head of circulating water, the vacuum might cause the water seal to rise in the pipes and so to the engine, causing some little trouble (if a new cylinder or a blown off low pressure cover may be classed as such!) To prevent this, non-return valves or syphon bends are always fitted. An automatic atmospheric exhaust valve is also, of course, always added. For neatness and cheapness this type is to be strongly recommended. Unfortunately it has that, to him, great objection: the inability to return the condensed steam as feed water to the boilers. The cost of this condenser is as low as £0 9 per E.H.P., including the circulating pumps to raise the water to sufficient head, usually not less than 25 feet, for the purpose of supplying the condensers. The author suggests an interlocking arrangement, so that the water may not be shut off before the engine has been shut down, as non-return valves do not always act.

Jet Condensers.

The last type here mentioned was the first to be adopted, viz., the old jet condenser. In this case the air pump has to be large enough not only to clear away the condensed steam and air, but also the whole of the injection water, no circulating pump being necessary except it be for re-cooling. The amount of power required to drive the air pump is 2 per cent. of the total engine output, and the cost is £0·88 per E.H.P. This may be dismissed at once by saying that this type is effete so far as electric power stations are concerned.

Circulating Water.

As to those cases in which no natural source, such as river, sea or canal, is at hand from which water for circulation is obtainable, there are many ways for dealing with the cooling of water; amongst them being the cooling ponds, cooling sheets as at St. Pancras, and by spraying over a pond such as is extant at Croydon and Newcastle, and is being adopted at Cheltenham and elsewhere; also towers as at Brighton, the Central London, and as the author intends adopting at Sunderland.

There is usually no warrant for adopting cooling ponds, the cooling area required to equate the increase from the steam being so great, and ground being, as a rule, far too valuable.

A simple method was adopted at St. Pancras, consisting of a series of corrugated iron sheets over which the water was allowed to trickle. This system, however, requires such a very large cooling area, and the wind pressure on the exposed area is sometimes so great as to

make an adequate system too bulky to be practicable. Of course, a large reservoir was in connection with this, the cooling going on throughout the 24 hours, and the temperature of the water rising considerably at times of full load, which was reduced to normal temperature during the hours of light load.

The system of spraying through specially constructed hydraulic nozzles over a large reservoir is very successful, but unfortunately this, too, requires a large ground space, though in inland provincial stations it would be a most excellent method. The ground space is about 24 square feet, and the price about £0·9 per H.P.

The author's opinion is that towers, with an artificial air draught, offer the most ready method of dealing with this important matter. Towers do not take up much room, the ground space per 1,000 H.P. being only 100 square feet, the vapour is taken away from a good height, and the amount of auxiliary power required for driving the fan is only 0·8 per cent. The ground space is about 0·15 square feet, and the cost £1·05 per H.P.

Allusion has been made to the necessity of brass-ended pumps for condensing plant. There is one other point, viz. the elimination of oil from the hot well water, which must be effected before the water is fed into the boilers. In most engines nowadays, such as Belliss, Allen, or other high speed marine types, very little oil need be used; in fact, the engines at Sunderland of the former type are run almost without any oil in the cylinders, and at the last inspection the cylinders were in splendid condition, and showed no signs of wear. Almost all enclosed engines are now constructed with outside glands on the cylinders, and with lantern glands with drains returning to the crank chamber.

By this means oil is not now sucked up from the crank chamber into the low pressure cylinder, and the amount of oil present is therefore very small. There are several filters on the market now which profess to deal with the oil in water, and no doubt do so to a great degree, but it is a different matter to eliminate oil which becomes saponified and so intimately mixed with the water. A careful selection of the oil, or the replacement of cylinder oil by graphite, for example, will minimise this trouble.

The author disclaims any novelty in this paper, and has merely laid the same before the Association as a nucleus for discussion, which, it is hoped, will be beneficial to us all.

The weight of steam per E.H.P. is taken at 20 lbs. throughout.

ELECTRICAL MOTOR CARRIAGES.

A few days ago we paid a visit to the exhibition of motor cars and motor cycles at the Agricultural Hall, Islington. There was an abundance of steam, gas, and oil vehicles, and also a very fair collection of electrical carriages, or "electromobiles" as our American namesake has ruled that they shall henceforth be called. Let it not be thought that we propose to abide by the ruling of our contemporary in the matter. We are inclined to think that far too much space has been devoted by our contemporaries, particularly in America, to a consideration of the question of whether a motor car shall be called a motor car or something else. "Electromobile" may be all right for some vehicles, but "immobile" would be a more accurate definition for others, and when a motor car has come to a sudden standstill, we have heard an even shorter word used. There is greater need for serious discussion as to improvements in the method of pro-

Fig. 1.

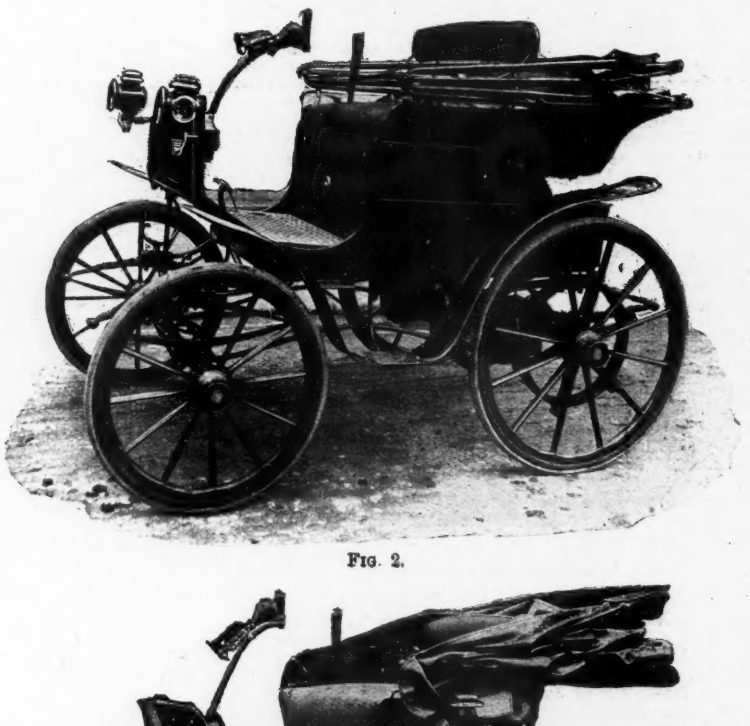


Fig. 2.

Fig. 3.

pulsion, the design of the carriage, and so on, than for squabbling as to whether "John" having been duly christened shall be known as "Jack," or "Richard" as "Dick." So far as the Agricultural Hall show is concerned, we were certainly struck with the improvement which is being made in the design of horseless carriages, particularly in those propelled electrically. Some of them are now quite passable without the noble steeds which were essential to give the earlier designs a decent finish.

An arena was specially arranged for conducting trials, and some runs in progress during our visit demonstrated how easily and excellently the motor car may be controlled, how noiselessly and smoothly the electrical vehicle can glide along as compared with the continuous thumping, &c., &c., of the other classes of cars. We regret we are not in a position to pass an opinion upon the performances of the artistes who contributed to the musical part of the arrangements, for the management had wisely or unwisely erected the concert stand in the centre of the arena. Motor cars dodged to and fro around the stand seeing how near they could go to it without touching it, and one may well imagine that music either vocal or instrumental accompanied with the musical humming and buzzing and growling of the motor cars, as they described their respective circles around it; the blowing of shrill whistles and the hideous warning notes given out by the respective drivers, was somewhat weird, to say the least of it. It was a mixture of good things which did not altogether suit our ultra-refined taste.

But to turn to exhibits more within our province, the Crowdus Accumulator Company, also Messrs. Le Carbone, had exhibits of their sundry specialities. Messrs. Shippey Bros. showed models of the Riker carriage motor, the Paragon motor and various accessories for electrical motor cars.

Mr. Carl Oppermann, of Clerkenwell, exhibited a patent electric Victoria car of very neat design, and which was conspicuous for its smooth and noiseless running. The accumulators are carried in a strong case which is readily detachable, underneath the body, and being suspended on steel springs they are not detrimentally affected by vibrations caused by unevenness of the roads. These accumulators when fully charged will furnish sufficient energy or current to propel the carriage about 40 miles at about 8 miles an hour. The electric motor (made specially by Mr. Oppermann) is claimed to be light and efficient. This is carried in a suitable steel frame suspended under the seat, and drives, by means of a special silent gear, an intermediate shaft furnished with a differential gear enabling the carriage to turn corners with the utmost facility; at the ends of this shaft are two specially designed silent working chain pinions, which transmit the power by means of chains to a suitable chain wheel bolted on to the inner side of the hind road wheels. The actual weight of the complete Victoria is 28 cwt., of which the accumulators weigh 12 cwt. We understand that this system is protected under home and foreign patents.

The Joel Electric Carriage Motor and Battery Syndicate, Limited, had on view a specimen of Joel's new patent underframe fitted with electric motor cars, all ready for the carriage maker to fix to the body of the motor car. Messrs. Joel make the underframe and motor part according to the requirements of the motor car which is being built at the carriage works.

Undoubtedly the most striking electrical exhibit was that of the Electrical Undertakings, Limited, of Camden Town, N.W. This Company had on exhibition some specimens of the cars made by them under the Leitner patents, including the four-wheeled electric buggy, which acquitted itself so excellently in a recent contest, both in hill climbing and in long distance trials. The vehicle has this year made a record run to Brighton and back, and a note on this subject recently appeared in our "Traction Notes."

The weight of this buggy (which we illustrate) is about 15 cwt., the batteries being about 400 lbs. weight, and the capacity about 10,000 watt-hours at 15 amperes rate, corresponding to 8 to 10 miles an hour. Distances of from 50 to 70 miles have been run on average roads on a single charge at about 10 miles an hour; six speeds forward, two speeds back. Zero or stop puts on brakes. Its minimum speed is about two miles an hour; the maximum speed being 30 miles an hour. The speeds are not materially increased going down hill, as the carriage checks itself automatically and charges back. There are two 2-H.P. motors, working up to 4 H.P. each, making a total of 8 H.P. Two varieties of the above carriage are built, one (smaller) running about 30 miles and built on cycle principles with motor working up to 4 H.P., the other (larger, ampler, and more comfortable) going up to 80 miles at great speeds and of still greater hill-climbing powers, and motors working up to 10 H.P. Fig. 1 shows this buggy without hood and fig. 2 with hood. Another very similar car is shown in fig. 3.

THE VOLTA CENTENARY.

Congress of Telegraphists at Como.

[FROM OUR SPECIAL COMMISSIONER.]

(*Continued from page* 6.)

The International Congress of Telegraphists which took place at Como was conceived and carried out in the most sumptuous style. The objects of the Congress, as set forth in the convening circulars, were as follows:—"To discuss, from an international point of view, questions relating to the professional interests of telegraphists, and the practical service of telegraphy." The Congress was to be a part of a series of celebrations in Italy in honour of the centenary of the discovery of the voltaic pile. An international subscription was made for the purpose of laying at the foot of the statue of Volta in his birthplace, Como, a bronze crown as a tribute from telegraphists of all nations. The "Committee of Honour" was presided over by the Italian Minister of Posts and Telegraphs, and was under the direct sanction of the Government. The municipalities of Milan, Como, Bologna, Florence, Rome, and Bellagio also took part in the organisation, and extended invitations to the Congressists to visit their various towns. Success was thus assured.

England was represented by one delegate and five Congressists. The delegate was Mr. C. H. Garland, of the Central Telegraph Office, who was also President of the English Volta Sub-committee, and the five Congressists were as follows:—Mr. G. S. Lacey, Assistant Superintendent Foreign Branch C.T.O.; Mr. Bazeley, Superintendent Telegraphs, Cardiff; Mr. Smith, Telegraphist, Edinburgh; Mr. J. Cameron, jun., Telegraphist, Glasgow, and Mr. J. Gennings, who attended as Editor of the *Telegraph Chronicle*. The Postmaster-General kindly granted special leave to the representatives for a fortnight, and subsequently, at the request of the President of the Congress, extended this leave for a further five days, to permit the representatives to follow the programme to the end.

The proceedings commenced on Tuesday, May 30th, at Milan, where a reception was held at 9.30 p.m. in the *foyer* of La Scala Theatre. The mayor and municipal officers of Milan were present and received the visitors, who numbered over 200. They included representatives from practically the whole civilised world. Japan, South America (Argentina), and North America (U.S.) each sent representatives, whilst France and Germany sent over 30 each.

On Wednesday, May 31st, the representatives proceeded to Como, where they were received by the municipality, the whole town being decorated and the inhabitants *en fête*. The Congress was formally opened at 3 p.m. by the Minister of Posts and Telegraphs, the Marquis of San Giuliano. We live, he said, in an epoch in which sentiments still have a country, but ideas have no country. We are all patriots in heart, and cosmopolitan in spirit. A century had passed since Volta had, for the first time, produced a constant current of electricity, and he claimed that all the developments of that century had sprung directly from the discovery. The constant peaceful intercourse thus made possible between nations tended to dissipate national prejudices, to soften national antipathies, and to set up friendly relations between all the nations of the earth. The speaking was continued by the Mayor of Como, Signor Cadenazzi, Signor Colombi, of the Organising Committee, and the following chiefs of delegations: Mr. C. H. Garland (England), M. Amiot (France), Sig. Alimenti (Rome), Sig. Pieri (Milan), Mighetta (Naples), and König (Austria).

The Congress having been thus inaugurated, the delegates dispersed, to meet again at 6.30 at the Grand Hotel Plinius, where a banquet was given in their honour, at which the Minister presided. Some 300 guests were present. In the evening the whole town was brilliantly illuminated in honour of the Congress.

On Thursday, June 1st, the international tribute to Volta was unveiled. It consisted of a heavy bronze tablet, fixed to the base of the statue in the Piazza Volta. To the lower portion of the tablet was attached a large bronze wreath. On the tablet were inscribed the following words:—

OMAGGIO
DEI TELEGRAFISTI D'OGNI NAZIONE
NEL PRIMO CENTENARIO
DELL' INVENZIONE DELLA PILA
MDCCCXCIX.

The oration was delivered by M. Baudot, honorary president of the French delegation, who is the inventor of the multiplex type printing telegraph, which bears his name. Speeches were also made by chiefs of the foreign delegations and the Mayor of Como. A sonnet, composed by M. Leonce Depont, Professor of Poetry at the French Academy, was recited by M. Rozet, and the delegates then marched bare-

headed past the statue. Large crowds witnessed the ceremony.

At half-past 1 o'clock the Congress opened under the presidency of M. Amiot, of the French delegation. Signor Colombi, of the Organising Committee (Milan), and M. Foret, of the French delegation (Paris), read papers on the International Exchange of Staff. The papers dealt with the advantages which would be derived from some system of exchange of staff which would familiarise the telegraphists of one country with the language and methods of the other countries, and facilitate international working. The Congress expressed its sense of the importance and utility of such a system by registering its unanimous opinion in its favour. An interesting paper on the importance of a knowledge of foreign languages by telegraphists was read by M. Stricker (Schaffhouse). Signor Brambilla, of the Organising Committee, read a *résumé* of a lengthy paper submitted by Mr. J. Nicolson, of Buenos Ayres, on "Telegraphic Signs in Combination with the Vocabulary of an Agreed Language." The author set forth a system of signs which, in many respects, resembled the Morse signs, and were based upon the same principles. He claimed, however, to have introduced some improvements upon the older alphabet. The system has already been noticed in many quarters. The Congress thanked Signor Brambilla for the trouble he had taken in the preparation of the *résumé*. Congress then adjourned until the following day.

In the evening the La Scala (Milan) Company and orchestra gave a special performance of "Verdi's *Otello* in the Theatre Social," at Como. The whole of the delegates and Congressists were present.

On Friday, June 2nd, an excursion was made to the tomb of Volta at Camnago, and the representatives were received afterwards at lunch by the Abbe Guanella at "La Binda."

The Congress re-assembled at 2 o'clock under the presidency of Senor Olmi, of the Argentine Republic. M. Longuet, of the French delegation (Paris), and Signor Spagnolo, of the Roman delegation, read lengthy papers on the question of Sunday rest. The Congress agreed that so far as was consistent with public convenience, Sunday labour should be restricted, and that the rights of the staff to Sunday rest should be recognised by an allowance in time or money for all Sunday work performed. Signor Colombi, of the Committee of Organisation (Milan), and M. Prevot, of the French delegation (Paris), read papers dealing with the necessity of offering some recompense for exceptional professional ability in order to encourage a healthy emulation among operators, which would improve the efficiency of international telegraph service. The papers were well received, and Congress registered its opinion in favour of such an encouragement being offered, the form to depend on national exigencies. Mr. C. H. Garland, of the English delegation (C.T.O., London), read a paper on "Pension Systems." He set forth the conditions under which pensions were granted in England and in Holland, France, Germany, &c., and made a comparison of the underlying principles. At his request, Congress expressed its opinion that the State should accept some responsibility for the widows and children of officers dying in active service, and that pension systems should contain some provision for this end. Mr. Garland moved an instruction to the Permanent Commission charged to carry out the wishes of the Congress to collect and publish in the international organ the details of the pension systems in every State for the purpose of setting up comparisons, and to form the basis of work in the directions previously indicated. Congress unanimously adopted the English delegate's proposition.

Signor Colombi, of the Organising Committee (Milan), read a paper on the "Facilitation of Travelling for Telegraphists who profit by their Annual Leave to Travel in Foreign Countries for Purposes of Study." It was suggested that efforts should be made, with the aid of the various administrations, to obtain for travelling telegraphists reduced fares and assistance of companionship in the countries they visited. Congress expressed itself strongly in favour of such work, which was left in the hands of the Permanent Commisssion. Congress then adjourned for the day.

In the evening the Società Générale Impregati Civili (General Association of Civil Employés) gave a reception at their headquarters, Via Unione, 10. The Congressists attended in good numbers, and a very pleasant evening was spent.

On Saturday, June 3rd, Congress re-assembled at 8 a.m., under the presidency of Cavalier G. Angelini, of Rome, Mr. C. H. Garland, London, being elected vice-president. Signor Brambilla, of the Committee of Organisation (Milan), and Signor Perisi, of the Neapolitan delegation, read papers on the question of the institution of an international journal for telegraphists. M. Amiot, of the French delegation, suggested that the further question of the election of the Permanent Commission should be taken with this question. Congress agreed, and M. Amiot then proposed that the Roman sub-committee should form the Permanent Commission, and that the journal *Pro Congresso* should be altered and continued as an international organ. Congress agreed. M. Amiot then invited the Congress to sit in Paris next year on the occasion of the Great Exhibition. The invitation was accepted with acclamation.

M. Amiot, chief of the French delegation, read a lengthy "*exposè* on the State of Professional Associations in France." Cavaliere Angelini, on behalf of the Roman Committee, thanked the Congress for appointing them as the Permanent Commission, and declared the first International Congress to be closed. Votes of thanks to the Minister, presidents and other officers, and Organising Committee concluded the business. The proceedings throughout were conducted in French.

The delegates were taken by special boat to Bellagio, where they were entertained at lunch by the municipalities of Como and Bellagio. Some 400 guests sat down, and speeches were made by the Mayors of Como and Bellagio, and the chiefs of the foreign delegations. Returning to Como, a presentation was made to the mayor in the Town Hall. The presentation took the form of a gold medal commemorative of the visit of the Congress to Como, and each chief of foreign delegations presented a copy of the National *Cocarde*, which had been worn during the Congress. The delegates then proceeded to Milan, where a fresh series of functions commenced.

(To be continued.)

THE INSTALLATION OF STEAM BOILERS.

IV.

No part of a flat-ended cylindrical boiler is so important as the end plates. Strictly speaking, the ends of a cylindrical boiler should be hemispherical and of less thickness than the shell, but practical considerations demand flat ends, the chief argument in favour of these being, perhaps, the difficulty of attaching the furnace tubes to ends other than flat. The end plates must therefore be considered as flat stayed surfaces. The stress upon the end of a boiler is obviously found by multiplying the area of the circle of the shell by the pressure per unit of area, less the product of the pressure by the circular areas occupied by the furnace tubes. Thus in a boiler of 8 feet diameter at 150 lbs. pressure the furnace tubes have an outer diameter of about 40 inches, and the load is about 317 tons. This is carried on the three circumferential seams of rivets. At the front end these have diameters at the rivet-holes of about 101 inches and 42 inches, or a total of 580 inches. The tension is thus nearly 1 ton per 2 inches of circumference. As the shell angle iron ring will have two rows of rivets there is a riveted circumference of about 900 inches, or 1 ton to each 3 inches. This is equal to about 1,500 lbs. on each rivet. But gusset stays are added to take up part of this stress. These stays require very careful design, and have only attained to their present state by a process of evolution and survival. Originally the rivets of the angle irons that attached the gusset stays to the end plates were brought very close to the ring of rivets that attached the furnace tubes. Observation showed that severe corrosion very usually developed round the furnace angle irons, and in the root of the angle iron, and also in the end plate, at the lower ends of the gusset angle irons. Such corrosion was worst at the points opposite the gussets. When this cause was recognised it became usual to cut out one or two of the

lower rivets of the gusset angle irons. Then it became usual to leave this space when constructing. A distance of 6 inches was fixed upon; this became 7 inches, then 9 inches, and now it is 10 inches. The reason for this "breathing space," as it is termed, is that when at work the furnace tubes arch up and press outwards against the end plates. This produces a bending that is most severe at points where thicknesses stop, as at the edge of an angle iron.

The Manchester Steam Users' Association adopt the system of design as shown in fig. 5. A 10-inch circle is drawn

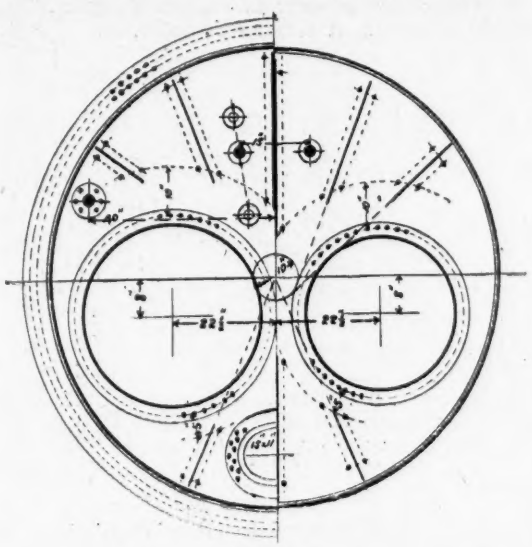
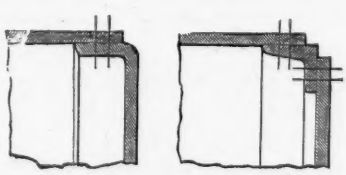


Fig. 5

about the centre of the boiler. The central and outer gussets at the front end are drawn radially, and the intermediate gussets tangentially to this circle. At the back end the middle gusset alone is central, the remainder being all tangential. About the centre of the furnace tubes at a radius of 10 inches more than the radius of the ring of rivets of the furnace angle irons, circles are struck on which are placed the lowest rivets of the gusset stays. Partly for giving access to the bottom of the shell, but also partly for giving elasticity to the end plate, the furnace tubes at the back end are about 6 inches smaller in diameter than the furnaces, and the back end plate is either flanged inside the shell as in fig 6, or attached by an inside angle iron as in fig. 7.

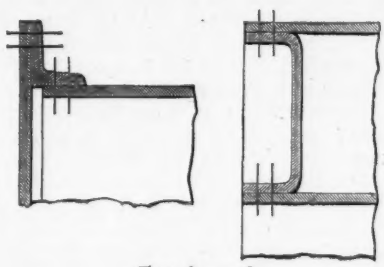


Figs. 6 and 7.

The front end plate, however, must be attached by an external angle iron as in fig. 8, otherwise there would not be room for the furnace angle irons inside the boiler. The rivets are double, and the front end plate of a boiler is, therefore, very much larger than the inside or nominal diameter of the shell. The end plate may, however, be flanged outwards and inserted within the shell as in fig. 9, the holes for the furnace tubes being also outwardly flanged This dispenses with the rings of angle iron, and saves the space they require, and possibly it may help to prevent grooving. This construction may be seen in a boiler at the electric station at Coventry. Obviously such a construction is favourable to the machine riveting of these important ring seams.

All gussets are held both to the shell, and to the end plates by, and between, two angles, and are tightly nipped by properly-formed rivets, not by bits of bent bar iron. No work of this type should be permitted, as the gussets are exposed to the most severe stress towards their inclined or inner edges, they should be so cut that these edges nowhere fall within a distance of, say, 2 inches of the straight line joining the outer rivets of the angle irons on the other edges, as in fig. 10. This prevents undue tearing stress on the edge of the gusset.

The modern tendency is to dispense with longitudinal bolt stays in Lancashire boilers. When applied they should be at most 15 inches apart. They will then come between



Figs. 8 and 9.

the central and outer gussets. They require to hang slack and their effect in restraining movement of the end plates ought not to be externally visible. They should be slung by hooks from small brackets riveted to the crown of the boiler. They are, however, very little employed, as stress cannot well be apportioned to them, and the furnace tubes are supposed to be amply sufficient to take care of the two halves of the boiler should a failure occur in the ring seams. The disastrous explosions of plain cylindrical boilers that arise from tearing of the ring seams do not occur with Lancashire boilers. In these boilers seam rips

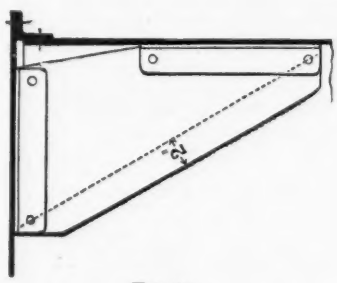


Fig. 10.

occur usually on the shell bottom where the longitudinal bolt stays do not help, and these rips are harmless and merely let out the boiler contents, the furnace tubes meanwhile holding the boiler ends together. Mention has been made of the suspension of any bolt stays from small brackets. Various small brackets are employed inside a boiler for suspending scum troughs, feed pipes, or anti-priming pipes. All such brackets require to be strongly riveted to the shell. No studs are permissible.

The duty of the gusset stays is thus to hold the end plates reasonably flat and yet not unduly rigid. As we have already pointed out, the space of 10 inches is left to give elasticity, and this wide unstayed surface seems to offer an example of a flat unstayed area, capable of standing a pressure in excess of anticipations. Yet even with the 10-inch breathing space there is quite enough rigidity. No extension is allowed by flat gussets. Hence our suggestion that possibly an advantage might be found from the employment of more or less corrugated gussets that would yield slightly and permit of some movement of the plate above the lowest rivets of the gusset angle irons. We believe some such practice could be experimentally determined, and that it would prove beneficial and conduce to longevity. With regard to the system of construction shown in fig. 9, it may be remarked that the large diameter of modern boilers renders it somewhat difficult to fire such high furnaces. In a 7-foot boiler the front end plate is only about 8 feet diameter.

The furnace centre is about 3 feet 4½ inches above the floor plate. In an 8-foot boiler the furnace centre will be fully 3 feet 10 inches above the floor plate. The construction shown in fig. 9 reduces this height by nearly 6 inches, and may prove very convenient at times. While on the subject of end plates, it may be named that the glass water gauges are usually fixed as shown on the left side of fig 5, slightly inclined from each other, the lower fittings being placed 12 inches apart and about 13½ inches above the boiler centre line. This brings them about level with the ring of rivets of the furnace attachment. An ordinary length apart is 21 inches vertically. Both the bolt stays and the glass gauge fittings are indicated in fig. 5, as also is the feed inlet block which is riveted to the front end plate and studded to receive the feed valve. In an 8-foot boiler the feed inlet is about 16½ or 17 inches above the centre line of the boiler, and as near to the side of the shell as will permit the internal flange pipe to lie comfortably, this internal pipe being slung from brackets as above described. If a scum trough is supplied, and this is a useful adjunct, its place is on the opposite side of the front end plate from the feed inlet in identically the same position. The longitudinal bolt stays, if applied, are to be held to the end plates by a deep nut and washer inside and out, the diameter of the bolt thread being about 2 inches and the washers being very little larger than the nuts, or, say, 5 inches. Large washers are a mistake, causing much rigidity. The spacing of gusset stays is such that their centre lines come 22½ inches apart at a distance of 48 inches from the boiler centre. It would, perhaps, be better to state the angle in degrees, and to place the stays to the nearest half-inch. Thus an angle of 13½° worked to the nearest half-inch gives a spacing of 19½, 21, and 22½ inches in boilers of 7 feet, 7½ feet, and 8 feet respectively, and similarly for the gussets below the tubes an angle of 15° will give spacings of about 17½ inches, 19 inches, and 20½ inches in the three sizes named. If front end plates be designed upon the foregoing lines it will be found that they represent a system of compromise between more or less antagonistic forces, and that the general proportions cannot be far departed from with advantage. They are no one man's ideas, but the composite experience of 40 years of many observers. Upon the front end plate there is also fixed a double ended water level pointer extending close up to each water gauge glass. It is placed 10 inches above the furnace crown to mark the approved working level of the water.

(To be continued.)

INSTALLATION ESTIMATES.

Amount of Illumination.

No definite rules can be laid down with regard to the amount of illumination required for a given area. The show windows to a shop, for example, may be said to require 1½ candle-power per square foot of surface, on the average, but everything depends on the kind of goods which have to be displayed. Jewellery might require four or five times as much light.

For factories, again, it is difficult to lay down fixed rules; ordinary work rooms may have 1 C.P. for 10 square feet to 3 C.P. for 10 square feet, according to how close the operatives are placed together, whilst on floors which are mainly occupied by machinery, the best method is to allow one or more lights per machine, according to its size, and not to reckon by floor space.

The following table may be useful as a rough guide:—

	C.P. for 10 square feet.
Shops without show windows	6
Stores and small warehouses	2½
Private offices	2
General offices (where there are many clerks)	2½
Anterooms	1½
Drawing rooms (private house)	5
Dining rooms	3½
Bedrooms	2
Kitchens	1½
Subsidiary rooms	1

For an hotel the lighting would be:—

	C.P. for 10 sq. ft.
Drawing room	6
Dining room	10
Best bedrooms	4
Small bedrooms	3
Corridors	1½
Entrance hall	2½
Office	2
Kitchens	1½
Subsidiary rooms	1

Cost and Weight of Generating Plant.

It is frequently necessary to estimate the price of an electrical installation at a moment's notice, and as it is a moral impossibility to carry the prices in one's head the accompanying curves and tables may prove useful. As a check against estimates built up in detail in the usual way the writer has found them helpful.

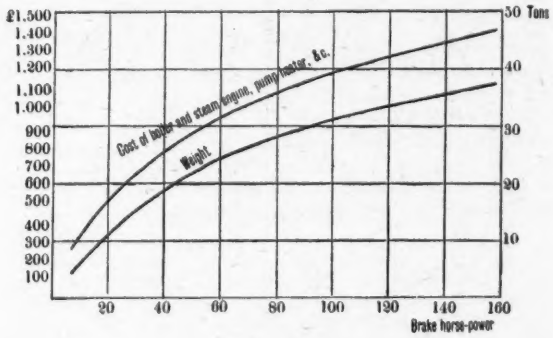


Fig. 1.

Fig. 1 gives the price and weight of a steam engine and boiler working at 120 lbs. pressure non-condensing. The price curve includes feed pump, injector, feed heater, steam exhaust feed and drain piping, and handrailing. It is assumed that the engine is of the moderate speed open vertical type and that it is situated close alongside the boiler.

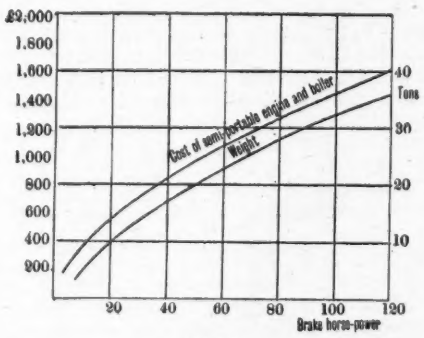


Fig. 2.

Fig. 2 gives the price and weight of semi-portable engine and boiler, including the usual accessories of such a self-contained plant with wrought-iron chimney, the whole being mounted on wheels in the smaller sizes. Such plants as these are frequently used for temporary work.

The prices of engines alone vary very considerably, more especially those of the high speed enclosed type which are usually coupled direct to the dynamos. For installations such as we are now considering, however, the engine may very well be of the moderate speed open type driving the dynamo by belt. Such engines, for example, as are made by Marshalls, Robey, Clench, Ruston Proctor, and others. These engines are especially suitable for foreign and colonial work because they are understandable by the ordinary mechanic and being made in large quantities the parts are

easily and cheaply obtained. The curves shown in fig. 3 are of such ordinary cheap non-condensing engines suitable for belt driving.

Fig. 4 gives curves for a gas engine plant, including water tank, gas bag, piping to tank, say, 8 feet distance, and extra fly-wheel to give steadiness in running.

The price of an oil engine (see fig. 5) is just about the same as a gas engine, in fact, many makers use the same

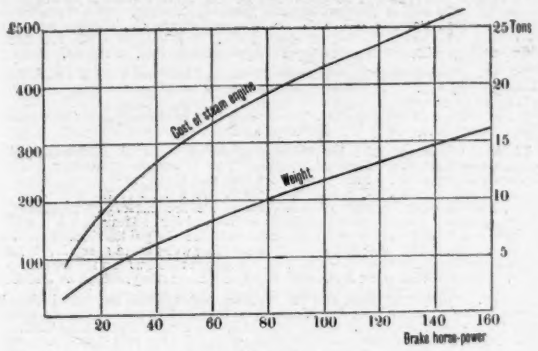


Fig. 3.

castings for the two engines, merely altering the valve gear. They are not, however, made in such large sizes. The prices given in the curve include water tank, piping, and extra fly-wheel.

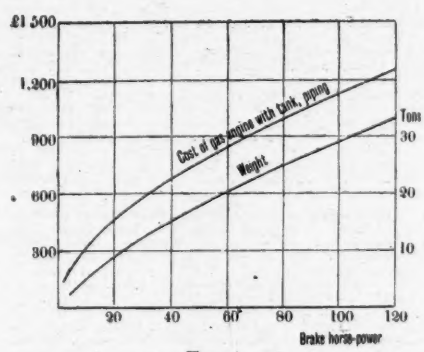


Fig. 4.

In all the above prices of engines, &c., the necessary foundation bolts are included, and weight curves include for packing cases.

In fixing the size of generating plant it is desirable to know how many lamps are likely to be burning at one time,

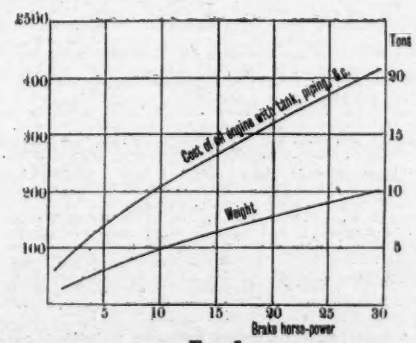


Fig. 5.

and also, assuming that the installation is successful, whether an increase of plant is contemplated, and, if so, to what extent. With this knowledge it is then possible to so adjust the size of the generating units that they fit in with the extensions and only one set of spares is required.

(To be continued.)

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

13,694. "Method of ventilating and keeping dry the wires and insulation of telephone, telegraph, or electrical conductors." F. F. Bennett and A. W. Thomas. Dated July 3rd.

13,719. "Improvements in tubular masts for wireless telegraphy and other purposes." J. A. Fleming. Dated July 3rd.

13,731. "Improvements in electric accumulators or storage batteries." G. V. Lagarde. Dated July 3rd.

13,732. "Improvements in electrical storage batteries." C. E. Lee. Dated July 3rd. (Complete.)

13,738. "Improvements in apparatus for exciting alternating current dynamos." C. D. Abel. (La Société Anonyme pour la Transmission de la Force par L'electricite, France.) Dated July 3rd.

13,773. "Improvements in electric traction." S. P. Thompson and M. Walker. Dated July 4th.

13,802. "Improvements in multi-rate electric meters." The British Thomson-Houston Company, Limited. (E. Thomson and F. P. Cox, United States.) Dated July 4th. (Complete.)

13,804. "Improvements in and connected with electric motors." P. M. Justice. (The Emerson Electric Manufacturing Company, United States.) Dated July 4th. (Complete.)

13,819. "Improvements in automatic magnetic circuit breakers." C. E. Starr. Dated July 4th. (Complete.

13,836. "Elastic and permeable electrodes for storage batteries." L. Tobiansky. Dated July 4th. (Complete.)

13,846. "Improvements in and relating to the manufacture of a composition from Rhea fibre applicable for electric insulation and other purposes." W. J. Cordner. Dated July 4th.

13,849. "Improvements in electric incandescent lamps." J. Atherton. Dated July 4th. (Complete.)

13,860. "Improvements in the method of distributing electric light." W. G. Inglefield. Dated July 5th.

13,907. "Improvements in the manufacture of primary batteries." C. H. Elliot and E. J. Fumber. Dated July 5th.

13,928. "Improvements in dynamo-electric machines." E. E. Brown. Dated July 6th.

13,930. "Improvements in magneto electric generators." F. Bryan. Dated July 6th.

13,939. "Improvements in or connected with street, road, or similar electric railways." J. Milnes. Dated July 6th.

13,940. "Improvements in or connected with electric alarms for clocks, also applicable to doors, windows and the like." J. Worrall. Dated July 6th.

13,955. "Improvements in apparatus or devices for giving electrical time alarms." W. Hausmann and H. Ritter. Dated July 6th. (Complete.)

13,980. "Improvements in apparatus for the electrical working of railway points and signals." Siemens Brothers & Co., Limited. (Siemens & Halske, Aktien Gesellschaft, Germany.) Dated July 6th. (Complete.)

13,981. "Improvements in electricity meters for measuring rotary phase currents." Siemens Brothers & Co., Limited. (Siemens & Halske Aktien Gesellschaft, Germany.) Dated July 6th. (Complete.)

13,991. "Improvements in or relating to monophase electric motors." W. P. Thompson. (E. Cantonio, Italy.) Dated July 6th.

13,994. "An improved key switch for electrical circuits, particularly adapted for incandescent lamp sockets." Veritys, Limited, and W. R. Riding. Dated July 6th.

13,995. "Improvements in and relating to the carbon feeding mechanism of electric arc lamps." Veritys, Limited, and W. R. Riding. Dated July 6th.

13,996. "Improvements in electric arc lamps." Veritys, Limited, and W. R. Riding. Dated July 6th.

14,010. "Improvements in means for use in the production of radiation and light by electricity." J. Swinburne and C. H. Stearn. Dated July 6th.

14,026. "A locking device for electric incandescent lamps and holders." W. J. Martin. Dated July 7th.

14,033. "Means for constructing a heliopile and for utilising solar rays and other energy for the purpose of generating, transmitting, storing, and using thermo-electricity." R. H. Dunn and S. S. Bromhead. Dated July 7th.

14,104. "Improvements in trolley heads for electric tramways." G. H. Nisbett. Dated July 8th.

14,105. "Improvements in electric generators or motors." B. Drafer. Dated July 8th.

14,140. "Improvements in or relating to electric motors." P. R. Jackson and Co., Limited, and J. S. Lewis. Dated July 8th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1897.

28,865. "Improvements in controllers for motors and brakes of electric cars." A. Gressman. Dated December 7th, 1897. Motor road vehicles.—In electric motor cars one handle is employed to apply the brakes, and to control the motor switch or rheostat. The brake spindle has loosely mounted upon it the crank handle. The upper end of the socket on the said shaft has ratchet teeth cut on it, with which teeth on the handle gear, so that when turned in one direction, the handle rotates the shaft, while it is free to rotate in the other direction without the shaft. The shaft of the switch or rheostat has loosely mounted on it a sprocket-wheel, geared to another loosely-mounted on the brake spindle. By means of a lever the crank handle can be locked to an internal gear made in one with the brake spindle sprocket-wheel so that the latter is rotated in either direction with the handle. The sprocket-wheel on the switch shaft has on its upper face a half-clutch engaging with a similar one on a plate keyed to the switch shaft and provided with a tail engaging with stops. When not locked to the handle, the wheel on the brake spindle is prevented from rotating by a clutch carried on a spring plate, and in a similar way the plate is held by a spring plate in gear with the wheel, so that when the tail is in engagement with a stop the said wheel can rotate without the plate. 15 claims.

22,951. "Improvements in instruments for measuring continuous currents." W. P. Thompson. (O. B. Shallenberger, United States.) Dated October 5th, 1897.

Relates to current meters.—A coil conveying current, is movable about a spindle on an iron ring between which and a co-axial similar ring a magnetic field is formed, the rings being fixed on blocks attached to the ends of a permanent magnet or magnets. The coil is balanced by another coil which may be a closed conducting circuit to damp the movements of the spindle, or may also convey the current; in the latter case both coils are wound on conducting frames to effect damping. Current is conveyed to the coil by two spiral phosphor-bronze springs carried by insulators on the spindle and connected to stationary arms. The coil carries a pointer over a scale. The rings are made with gaps to permit the placing of the coils on them, the gaps being afterwards filled up with magnetic material, or each ring may consist of two semi-circular pieces. The rings may be nearly surrounded by an iron ring secured adjustably between three screws; this ring shields the magnetic field from outside influences, and also serves as a means for adjusting its uniformity, and the proportionality of the deflections, through a large angle. 2 claims.

22,852. "Improvements in phase adjusting and regulating methods, and means for alternating current apparatus." R. Belfeild. (E. M. Tingley and O. B. Shallenberger, United States.) Dated October 5th, 1897. Electric phase adjusting apparatus.—A current exactly in quadrature or other desired phase-relation to the current in a given circuit, is derived from the latter for use in a measuring instrument or otherwise. In one arrangement the main current flows in coils and the derived current in a coil which is connected in series with an inductance between the mains; the derived current is adjusted to quadrature by connecting a non-inductive resistance in parallel with the coil. In another arrangement, the main current flows in a transformer with an adjustable magnetic circuit, the secondary of which supplies the coils, while the coils are connected without the resistance. In a third arrangement, the coils carry the main current, but the coil is supplied from the secondary of a transformer having two primaries connected in parallel between the mains; one primary is in series with an inductance, and the other with an adjustable non-inductive resistance or a condenser. The provisional specification described a modification of the arrangement having an inductance connected in parallel with the main current coils. 4 claims.

22,978. "Improved fusible cut-out for electric lighting and the like." J. Peschek. Dated October 7th, 1897. A tin, lead, or other fusible strip or wire is placed on a strip of mica, asbestos, millboard, or other incombustible material, so that it is in electric contact with thin brass, copper, or other bands wrapped round the ends of the strip. A strip similar to the first one may be placed over the first strip or wire to protect it. These contacts are clamped in position by two screws, the latter of which makes contact with the main, while the former screws into a metal block to which the leads are clamped by screws. To prevent damage to the screws and blocks by sparking when the cut-out fuses, shields are provided, preferably by bending the strips. These shields may be formed of some metal or alloy incapable of maintaining an arc. 4 claims.

23,097. "Electric conductor or cable." G. H. Nisbett. Dated October 8th, 1897. Air-space cables with paper or similar insulation are formed by passing wires and paper through tapering formers so that the folds come together. The formed tubes are passed through an assembling guide, and are twisted into a long-pitched spiral. The machinery employed consists of stationary reels and formers, the twist being imparted by rotating the take-up drum. The take-up motion is imparted to the drum by bevel and worm gearing. The provisional specification refers to a machine in which the twist is imparted by rotating the frame carrying the feed reels. An extra thickness or thicknesses may be placed between the folds. (Grant of patent opposed.) 2 claims.

23,260. "Improvements in automatic magnet circuit breakers." W. M. Scott. Dated October 9th, 1897. (Date applied for under Patents, &c., Act, 1883, Section 103, March 17th, 1897, being date of application in United States.) Relates to an automatic electro-magnetic switch or cut-out which operates upon either a predetermined maximum or a predetermined minimum flow of current. The magnets may be energised by the current to be controlled or by a controlling current. The switch arm is carried by arms pivoted near the bottom, and forced upwards by springs being provided for checking the movement. The contact-arm is held, when in engagement with the fixed contacts, by a latch engaging with a cam-plate pivoted. A second cam-plate is also pivoted, and is slotted to receive a pin carried by the first cam-plate. The resetting handle has a plug on the contact-arm, is pivoted, and carries a pin to set the cam-plate when the handle is fully raised. Two electro-magnets are arranged in connection with the circuits. When the currents exceeds a predetermined limit, the movable part of the core of the magnet is raised, lifting the pin and so releasing the catch. When the current falls below the limit, the part of the magnet falls, pulling down the pin and operating a lever the other end of which engages with the cam lever. The lowest position of the core is adjusted by the nut, and the action of the core is adjusted by limiting the distance that it may be drawn within the coils, or by means of an adjustable core moving in the fixed core. Instead of two magnets a differentially-wound magnet may be employed. Carbon contacts are arranged for taking the sparks. 8 claims.

23,267. "Improvements in apparatus for the electro-deposition of one metal on another." J. E. Bryant. Dated October 11th, 1897. Electro-deposition.—Relates to apparatus for depositing one metal upon another. It consists of a cylinder or barrel one end of which can be removed and closed by screws, is supported on axles and rotated by a driving pulley. The shaft to which one terminal is attached, passes through an insulating tube surrounded by a metal tube forming one axle, which itself passes through a stuffing box. The inner end of the shaft is bent upwards and then inwards, and supports by adjustable rods the horizontal anode plate of the same metal as is to be deposited. The opposite shaft is connected to the other terminal, and similarly passes through an insulating tube, a metal tube, and a stuffing box. It is connected to a metal disc from which copper strips pass along one end and the sides of the barrel to make contact with the articles to be coated. The barrel may be perforated and mounted within another vessel containing the electrolyte. The anode may be a cylinder, a polygonal prism, or a longitudinal section of either of these, instead of the plate shown. 4 claims.

23,352. "Improvements in the manufacture of electrodes for electrolytic processes." A. Zimmerman. (The Chemishe Fabrik auf Action vormals, E. Schering, Germany.) Dated October 11th, 1897. Electrodes are formed by coating glass, porcelain, mica, enamel, stoneware, or other similar material with an alloy composed of gold, platinum, silver, or other noble metal, and a small quantity of bismuth, or other metal which reduces the melting point of the noble metal, and enables it to be burnt in at a lower temperature. The metallic coating formed may be strengthened by electrolytic or galvanic deposits of the noble metals. 2 claims.

23,415. "Improvements in dynamos." J. Liddle. (E. W. Farnham, United States.) Dated October 12th, 1897. Relates to a magneto-electric machine, suitable for use upon a bicycle or other vehicle, for supplying an electric lamp or other electric signalling apparatus. The parts are contained within a cylindrical casing mounted rotatably on a fixed spindle, and driven by the tyre of one of the wheels. The field magnets and the armature are supported by a frame secured to the shaft, and motion is communicated to the armature from the casing by means of pulleys over which passes a cord. One end of the armature winding is connected to an insulated stud, upon which bears a brush in connection with a leading-wire; the other end is connected through the frame of the dynamo with the other leading wire. In one modification, the armature shaft is driven by an internally toothed gear wheel attached to the casing; in another, the armature and field magnets are arranged so that both rotate in opposite directions. 4 claims.

23,418. "Improvements in electromotors and dynamos." T. B. Murray and G. Johnston. Dated October 12th, 1897. Dynamos and motors, armatures, field-magnets.—An electromotor or dynamo is constructed with two armatures mounted on the same shaft, and each provided with one or more distinct windings, connected to their respective commutators. By varying the connection of the armature windings from series to parallel, or *vice versâ*, the speed of a motor may be varied. This may also be effected by varying the strength of the magnetic field. To obtain a sparkless commutation under such circumstances, a pair of smaller electro-magnets are arranged between the main magnets, the additional magnets being preferably energised by coils in circuit with the armatures. 1 claim.

23,470. "Improvements in electric incandescence lamps and apparatus or appliances in connection therewith." Dr. W. Nernst. Dated October 12th, 1897. Incandescent lamps, having incandescent bodies of magnesia or other oxides, are provided with resistant metal wires for heating such bodies to render them conducting. The incandescent body is fixed at the focus of a concave porcelain reflector containing a coiled platinum wire. When current is supplied to the wire, it heats the body until this conducts sufficiently to take current from a separate or parallel circuit. The supply of current to the wire may then be stopped, by hand, or by a cut-out operated by the current supplied to the body In a modified form the wire is wound in a refractory transparent cylinder, within which the incandescence body is fixed; or such enclosing cylinder may be dispensed with. In another modification, the cylinder is of porcelain, and either it or the incandescence body is supported by a spring and a core of a solenoid in circuit with the incandescence body, so that the heating cylinder is automatically withdrawn from the body when it conducts sufficiently. 6 claims.

24,130. "Improvements in mountings for the contact shoes of surface contact railways." The British Thomson-Houston Company, Limited. (W. B. Potter, United States.) Dated October 19th, 1897. Collectors. Shoes are carried by spring-controlled levers at each end of the vehicle. The lever is pivoted on a block mounted on a stiffened support depending from the axles. 4 claims.

24,150. "Improvements in electrodes for storage batteries." H. S. Lloyd. Dated October 19th, 1897. The plates or electrodes are made up of two or more layers of lead wires or strips with an intermediate perforated lead plate. The wires are preferably plaited together. The plate may be of material which will be dissolved or destroyed by the electrolyte. 2 claims.

24,155. "Improved joint box for electric cables." R. J. Hatton and W. T. Henley's Telegraph Works Company, Limited. Dated October 19th, 1897. Junction boxes for electric cables are formed of U shaped metal troughs in which the two ends are formed double, and rise only to the height of the middle of the cable, semi-circular recesses being left to receive the cable. The ends of the conductor are jointed before being placed in position. After being placed in position end pieces fitting round the cable and held by guides close the ends of the box. The pieces are separated by connecting webs and a space is filled with bituminous or other insulating material. A lid provided with a rib is secured by bolts. The external sockets are also filled with insulating material. 3 claims.

24,156. "Improved joint box for coupling underground and aerial electrical cables." R. J. Hatton and W. T. Henley's Telegraph Works Company, Limited. Dated October 19th, 1897. Junction boxes for connecting ground and aerial lines are formed of metal cases provided with lugs for attachment to posts or other supports. The bottom is perforated to receive the underground cable, and the insulators for the bare aerial lines. The cable is secured by packing and a gland, the several conductors being provided with connections for attachment to the ends of the bare conductors. The insulators are set by cement into the bottom of the box, and the conductors pass axially through them. The box is filled with paraffin wax or other insulating material, and the lid is bolted on. There is a dependent skirt round the box. 1 claim.

24,419. "Improvements in telegraphic transmitting instruments." G. Draper and W. Gaye. Dated October 21st, 1897. Transmitters for sending curb currents are arranged so that the duration of, and interval between, the signal and curb currents are independent of the time the key is held down. In one arrangement of the apparatus, the double keys are connected to cable and earth respectively, and their back contacts normally rest on a bridge connected to the middle point of the split battery. Each key is provided with a light spring extension which when raised makes contact with a bridge connected to a spring controlled pivoted lever. The front portions of the keys are insulated from the back portions, and are connected together so that either key will complete the local circuit through a magnet. The armature of the magnet carries a pointed lever which bears against a cam surface on the lever. The end of the lever plays between stops on two levers which are connected to the opposite poles of the line and curb batteries. The space between the stops is adjustable, and the frame carrying the levers can also be adjusted laterally so as to vary the duration and interval between the signal and curb currents. In modified arrangements of the circuits only one battery is employed, the opposite poles of which are connected to bridges, in one case the cable being connected to the lever. Condensers and resistances may also be employed. 3 claims.

24,421. "Improvements in systems for the transmission of electrical energy, and apparatus for use therein." N. H. Lake. (N. Tesla, United States.) Dated October 21st, 1897. Relates to a system for distributing electrical energy without the use of line conductors. The current from a generator is transformed into a current of excessively high pressure in the secondary of a transformer. One end of this secondary is connected to earth and also to the primary, and the other to a terminal which has a large surface, and which is maintained at a high elevation by a balloon, &c. The current flows through the rarefied air to a second terminal connected to the secondary of a transformer, in the primary of which are arranged the translators. The transformers preferably have two concentric coils, and the secondary should preferably be one quarter of a wave in length. 5 claims.

24,518. "Improvements in the construction of overhead lines of electric railways or tramways." P. Dawson. Dated October 22nd, 1897. Electric railways and tramways with overhead conductors, crossings and frogs for.—The underside has ribs, grooves, guards, to guide the trolley wheel; preferably the ribs are curved and a central guide is also used. The ribs, &c., are shaped so that the wheel runs on its flanges at the centre of the plate, or the plate may be inclined or otherwise arranged to guide the trolleys. The conductor wires are not cut, but are held in grooves on the top side of the plate by solders and by clamps and set screws. 7 claims.

24,521. "An improved frog for overhead conductors or trolleys of electric railways or tramways." P. Dawson. Dated October 22nd, 1897. Electric railways and tramways with overhead conductors. Conductors, movable frogs for. A part of the guiding ribs on the underside of the frog-plate is connected by a lever on its axis to a sliding bar which is normally held in one position by a spring. Trolleys which are to pass on to the branch line are provided with a projection which strikes the depending arm on a carriage sliding in the box on the frog plate. This carriage moves forward, and so operates the switch through the rod and then tilts when its roller comes opposite a slot in the top of the box so that the trolley can pass. A catch operated by a trigger lever holds the switch until the trolley has passed. Trolleys without projections pass on the main line, or the switch may be arranged to work for either direction. The main trolley wire is not cut, but is laid in a groove on the top side of the plate, and both it and the other wire are held by solders, clamps, and set-screws. 4 claims.

24,591. "Improvements in galvanic cells." A. Heil. Dated October 23rd, 1897. Primary and secondary batteries.—A primary battery consists of a zinc electrode and of a carbon electrode surrounded by equal parts by volume of graphite, manganese peroxide, and lead peroxide. The electrolyte consists of an aqueous solution of zinc sulphate, to which soda is added until the hydrated carbonate of zinc is precipitated in small flocks, which are maintained in suspension by forming the liquid into pulp by admixture with gypsum and sawdust or other absorbent materials. In the provisional specification, the use of the battery as a secondary battery is described, the electrolyte consisting of a solution of pure soda, and the zinc electrode being coated with zinc dust, while the carbon electrode is made as above described. 2 claims.

24,829. "Improvements in coin-freed mechanism applicable to gas, electricity, and like meters." S. Simpson. Dated October 26th, 1897. Gas meters, liquid meters, electricity, supplying.—Relates to the actuation and the price-charging arrangements. In one arrangement, after prepayment a segmental wheel is turned by a handle and drives a complete wheel in gear with it. Segmental wheels of various arcs can be put on the handle shaft laterally, or the set of wheels can be replaced by a pair of overlapping sectors. In another arrangement a cam on the handle shaft reciprocates a slide whence a variable ratchet feed is operated by a connecting rod. Coin action.—Normally the handle is prevented from being turned because a detent engages in a notch in a disc on the handle shaft, but when a coin has been put into a radial pocket in a drum it lifts the detent as the handle is turned through the small play allowed by the notch. In the second arrangement the slide contains the coin. Fraud preventing.—A cam prominence in the periphery of the disc holds the detent in the notch when the pocket registers with the insertion slot. 6 claims.